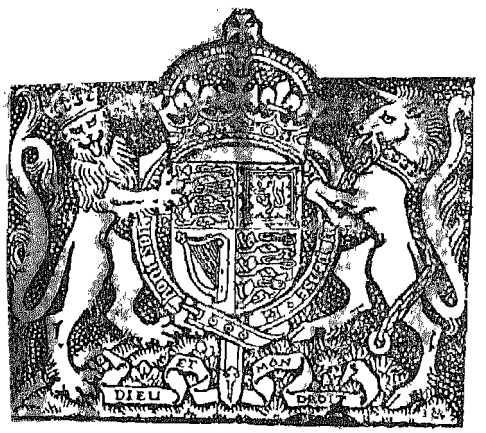
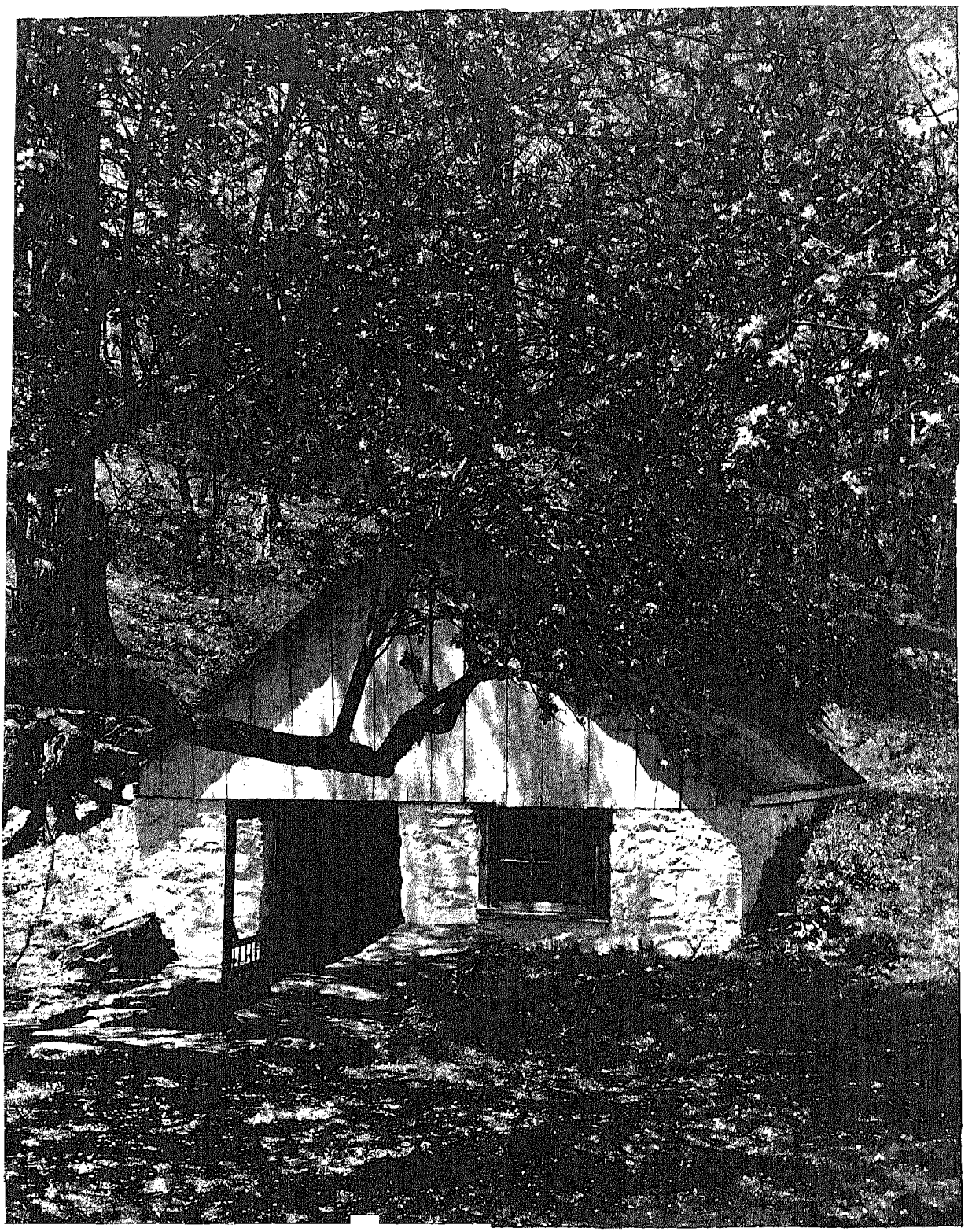


MGIPC—S4—III-1-93—22-8-45—5,000.

THE STORY OF FOOD PRESERVATION



OLD SPRINGHOUSE

THE STORY OF FOOD PRESERVATION

EDITH ELLIOTT SWANK, M. S.

ILLUSTRATIONS BY LUKE SWANK

H. J. HEINZ COMPANY

LIMITED EDITION, PRINTED AND BOUND 1943

PRINTED IN THE UNITED STATES OF AMERICA

Contents

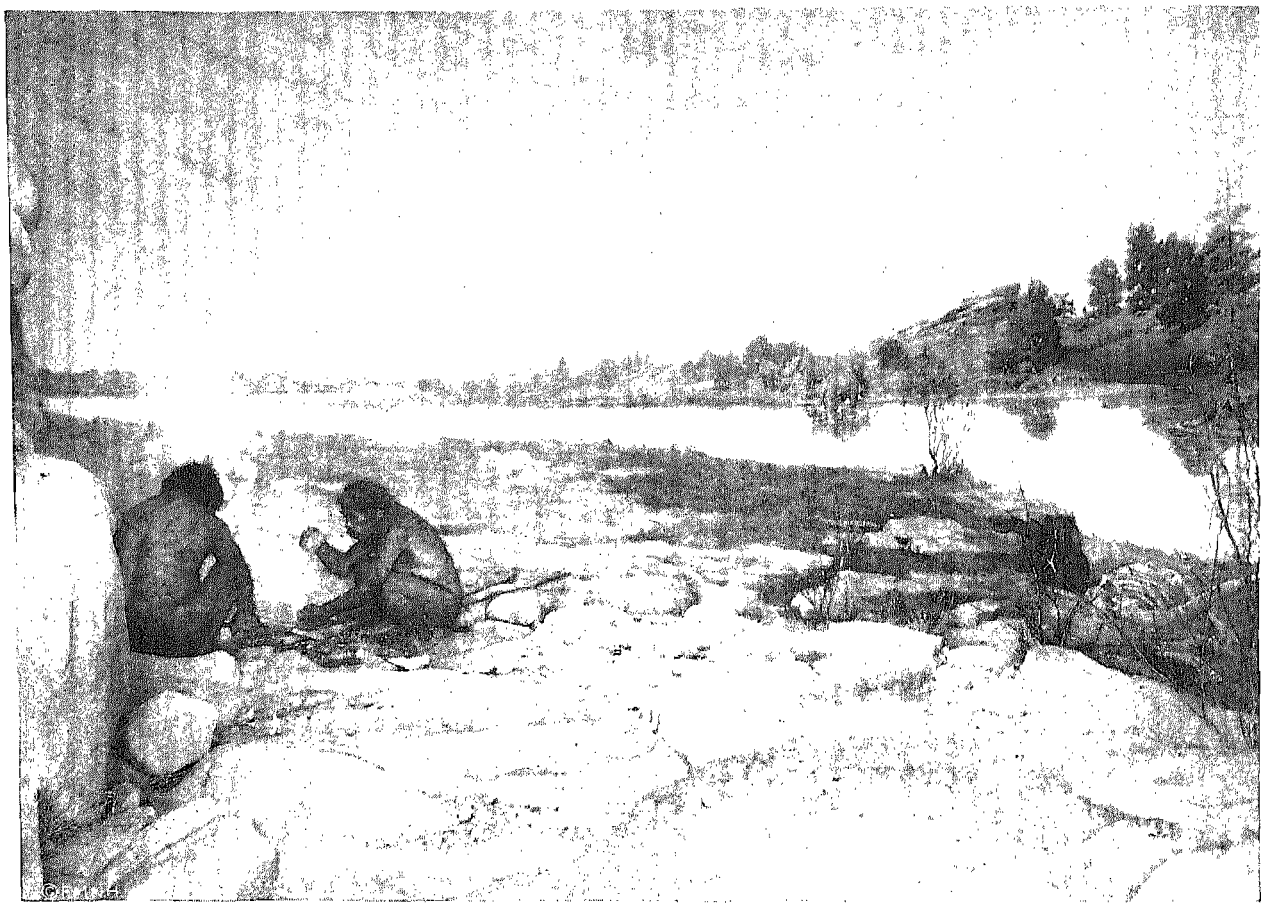
Introduction

Thousands of years ago our ancestors roamed the wild forests hunting game and picking seeds and berries. Man was a food gatherer in those days, not a food producer. There were no fields of corn nor wheat nor orchards full of fruit. The world was a tangled wilderness where man wandered with the animals. But he was cleverer than the animals, for he had a brain to think with, and a tongue to talk with, and a hand to grasp tools and weapons with. And so he became master of the animals and learned to kill them for his food. No one knows how these simple folk could have felled powerful beasts like the mastodon and the saber-toothed tiger, for their only weapons were stones and clubs. But big bones of these animals are still found mingled with flints in ancient caves and grottoes.

Deep in the forests and mountains man drove the cave bear from his den, caught the wild horse, snared the bison and the woolly mammoth. Along the lakes and rivers he hurled rocks at fish or clubbed them with clumsy harpoons. Then he grubbed for green things, too — roots and herbs and berries growing in the forests. He ate until he was satisfied and threw the rest away to rot. You see, he did not know how to save food for another meal; so there were times when he went cold and hungry, when game was scarce and his children died from want. Life was hard in those days, and none but the strongest survived.

Then man discovered fire and learned to cook his food and warm his cave. He clothed himself in skins and furs and invented stout new weapons to kill his foes. Life became easier and the population increased until there was no longer enough wild food in the forests for everyone. So people began to follow herds of animals about the country to be sure of a steady food supply. Then, because this was a very dangerous way to live, some of the families banded into tribes and wandered the world together, though when winter came they crept back to their caves and ventured forth only for short hunting trips. Sometimes the bitter cold and blinding snow kept the hunters huddled near the hearths for days. Then the scant supply of food at hand was not enough to keep their families. So they began to store a few foods in the fall. Dry foods like seeds and grains and nuts would keep well in a little cache among the rocks. Extra meat could be hung outside and frozen, or packed way back in the caves where it was cold enough to keep the game from spoiling. Then in time they learned to save more meat by drying thin slices in the sun or hanging a side of game from the roof of the cave. Sometime a hunter may have chanced to build a fire under this meat to warm his cave, and later noticed the pungent flavor and fine keeping qualities of flesh dried over a smoldering fire. And so smoked meat was added to his store of preserved foods. We do not know when man discovered salt. Probably he found deposits near salt springs or along the sea where the sun had evaporated tide water as it ebbed slowly back from the shore. But man soon learned this salt would prevent spoilage, too, when it was sprinkled between layers of meat or fish, or when he soaked his food in brine.

In time man discovered it was easier to domesticate wild animals than to follow them about the country. Then he could stay in one place, store his food, tend his flocks, and have a home. He began to grow a garden, too, and planted crops instead of searching for them in the forests. For tilling the soil he developed rough implements of stone and wood. It was a



Field Museum of Natural History

EARLY MAN

crude sort of farming he did on these first fields, planting his crops seed by seed and garnering the harvest by hand. But it meant food every day, even in winter when the fields were covered with snow and game was scarce in the forests. Man was a hunter still, but he was no longer dependent on the chase, because he had cultivated crops and domesticated flocks to feed him.

Even thousands of years ago farmers grew pears and apples in their orchards, peas and lentils in their gardens, oats and barley, rye and wheat in grain fields. A long, long time ago they learned to make cheese and butter from cow and goat milk, to ferment fruit juice into wine. Before our own historic time foods were preserved by storing, drying, smoking, salting, and chilling. And so, instead of the dull diet and periods of famine of former centuries, early man now had a variety of foods on hand when he needed them.

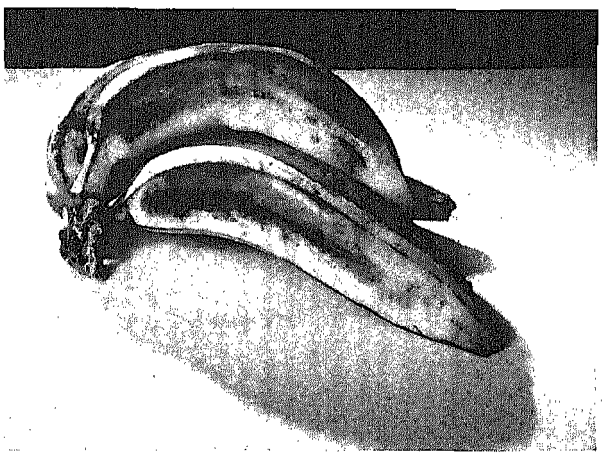
As man progressed, however, living grew more complex. When people began to crowd together in cities and spread from cold to tropic climates, such simple means of preservation were not adequate to prevent spoilage. But it was not until the era of industrial progress and scientific research of the nineteenth century that better methods were discovered. To prevent, by more perfect preservation, the natural spoilage that attacks all foods still remained one of man's greatest problems. The solution of this problem, by the development of modern types of preservation, such as canning and quick freezing, is among the finest achievements of science and industry in our times.

I. Why Foods Spoil

Almost all foods will spoil in time unless something is done to prevent spoilage. Milk sours, butter turns rancid, bread molds, fruits and vegetables rot, and meat decays. In order to avoid this deterioration we cook or can part of our food. The rest is put in the refrigerator, the bread box, or in storage bins. Damage to food is caused by what scientists call spoilage agents. There are so many of these spoilage agents that can change or spoil our foods it is really surprising anything stays fresh long enough to put on the dinner table. Some of these changes are so small we scarcely notice them at all. Maybe the color of the food is a little different or the flavor not quite so appetizing. But there are other changes like rot and mold and putrefaction that completely ruin our food. These changes come about in many different ways. Some are the result of just one spoilage agent working on a food. Others occur when several agents work together. A number of these agents work in such an obscure fashion scientists themselves are not quite sure how they affect our foods. But there are many more common spoilage agents with which we are all familiar. We have seen the damage they do to food in stores and warehouses, farms and factories, and even in our own kitchens. In order to preserve our foods these spoilage agents must be eliminated.

Air

Air, surprising as it may seem, can affect the color and flavor of our foods by a process known as oxidation. As you no doubt know, air is made up of a number of gases among which is a very important gas called oxygen. It is this oxygen which causes color and flavor changes in certain foods when they are left standing uncovered in the air. Fatty foods like nuts and butter are apt to turn strong and rancid. Fruits and vegetables change color from the air, too. You may have noticed how quickly mushrooms blacken after they have been picked, especially if they were bruised or broken a bit, and how soon bananas darken when they hang in the grocery store window.

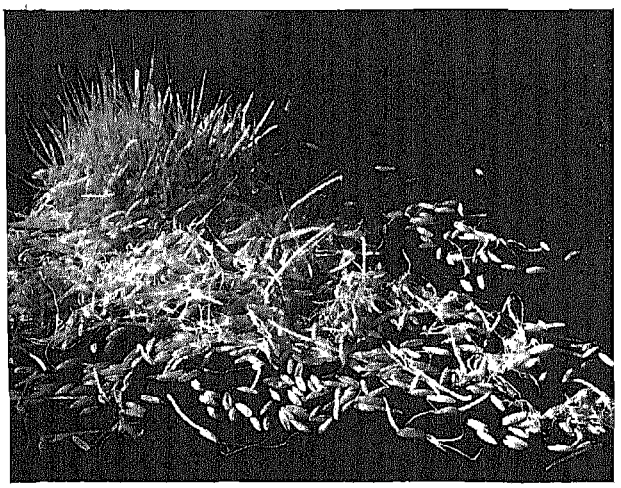


AIR DISCOLORS BANANAS

Bakery goods like cakes and cookies are likely to get stale from standing out in the air and should be covered in order to keep fresh.

Water

Water is necessary to almost all living things. But too much water is very destructive to foods. Heavy rains are apt to wash seeds from the earth, start wheat sprouting in the shocks, and soften vegetables so they burst and begin to rot in the fields. Sometimes a long rainy spell will cause foods to absorb water and start molds and mildew working. Even in the bread box it is hard to keep bread from molding in damp weather, and dry foods like salt very soon get lumpy and become hard to use. Floods do great damage to the farmer and the merchant, too. A stream may rise



WATER CAUSES GRAIN TO SPROUT

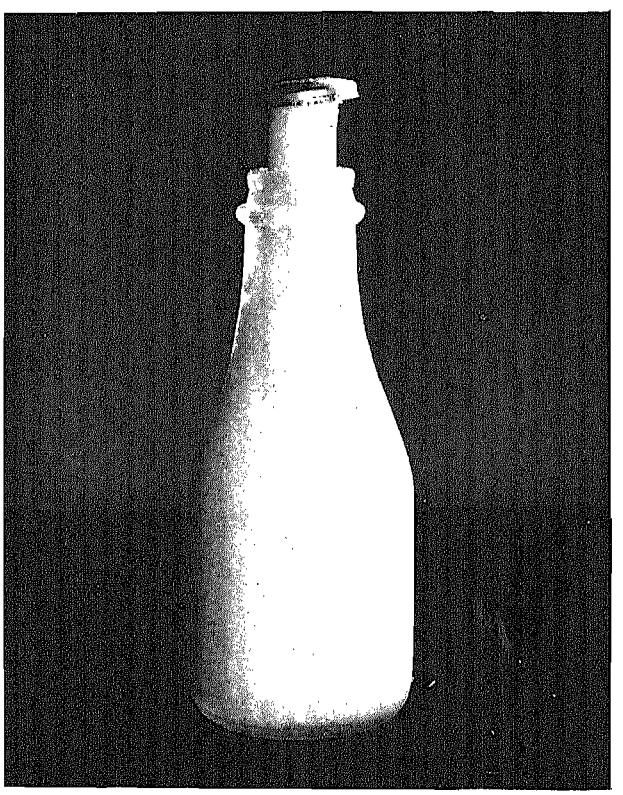
quickly and wash out whole fields of corn growing in rich river bottoms. Dry foods like grain and starch and sugar may be completely ruined when flood waters back up into warehouses where food is being stored. Sometimes water will seep into the hold of a ship carrying grain across the ocean and spoilage will set in. In most cases it is not the water itself that does so much damage. Water simply softens the food and permits other spoilage agents to break in and begin their work.

Extremes of Humidity

Extremes of humidity, either damp or dry air, have very damaging effects on food. In damp weather nuts begin to mold and fruits and vegetables will spoil. Baked goods like cookies loose their crispness and become limp and soggy even in the cooky jar. Hard candies get sticky, too, and chocolate candies turn grey. It is dampness in the air that does these things and spoils food for our use. Now dry air has just the opposite effect. It tends to draw off all the moisture and dry out food. You may have seen fruits and vegetables standing in a grocery stall getting dry and wilted looking. Unless they are stored carefully in very dry weather, eggs will dry up in the shell. All baked goods are likely to turn stale. In some cases the food itself is not affected by dry air, but the delicately flavored oils are evaporated and the food is left with a flat unappetizing taste.

Freezing

Freezing is damaging to many foods, especially those with large amounts of water in them. You know, when milk is left standing on the back porch too long in zero weather it soon freezes, expanding until the cap is forced up an inch or two, sometimes even bursting the glass bottle. When this frozen milk is thawed the texture is quite ruined by curdling, and the flavor is thin and poor. Vegetables and

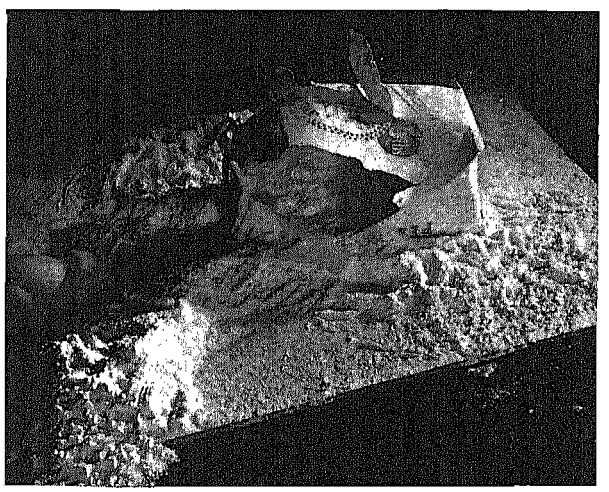


COLD FREEZES OUR MILK

fruits, left in a storeroom during sub-zero weather, become flabby and flavorless when they are thawed out. Even eggshells will sometimes crack from the intense cold, so that the eggs seep through leaving useless hollow shells.

Rats, Mice, Birds, and Insects

Rats, mice, birds, insects, and almost every animal alive will damage foods if they can get to them. Thousands of years ago, however, man learned to protect his foods from these enemies, with the exception of rats and mice. But the strongest warehouse is still not safe from the depredations of these wily rodents, who can gnaw and burrow their way into seemingly impregnable buildings. In this country alone, millions of dollars worth of food is damaged by rats and mice every year, both in our homes and commercial food institutions, in spite of almost constant vigilance against them.



RATS DAMAGE FLOUR AND CEREALS

Insects do not spoil a great deal of food in our own homes. Of course ants eat sweet foods and are a great nuisance, weevils spin webs destroying packaged cereals, and flies get in everything. But it is in commercial handling of foods, in warehouses and packing houses and stores, that insects cause the greatest trouble. All sorts of insects infest stored grains and legumes, such as peas and beans and lentils. They turn nuts rancid, spoil dried fruits and vegetables, lay eggs in fruits and fresh meats, live in salted and smoked meats, and even infest such manufactured foods as crackers, cereals, and spice.

Fire

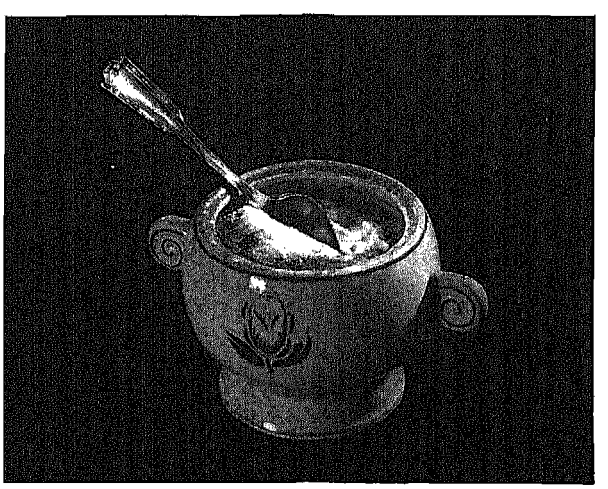
Fire, of course, can destroy all kinds of food. It may burn foods to a crisp on the kitchen stove, or, if a warehouse or store burns, it may reduce foods to a wisp of ashes. Even where food does not burn, it is likely to be charred or so damaged by smoke, ashes, dust, and water as to be ruined.

Dirt

Dirt is another great enemy of food, just simple, ordinary dirt. Now dirt in itself is not so harmful, but dirty food handled under unsanitary conditions repels us. Dirt is dangerous because it attracts vermin, and like dust, carries microorganisms with it. To overcome this, our homes and stores and food factories should be kept spotlessly clean.

Dust

Dust does more damage to foods than you would ever think. When a thin film of dust settles on an open bin of flour or a bowl of sugar it quite ruins the appearance of the food, and the only way you can get rid of this dust is to scrape off the top layer of the food and throw it away. But dust does greater damage to food than just spoiling its appearance. Those particles of dust you see floating so lightly in



DUST CAUSES MUCH DAMAGE

the air generally have tiny microorganisms clinging to them. These microorganisms are responsible for most food spoilage, so foods should be protected from them by keeping dishes covered on the pantry shelves and even in the refrigerator.

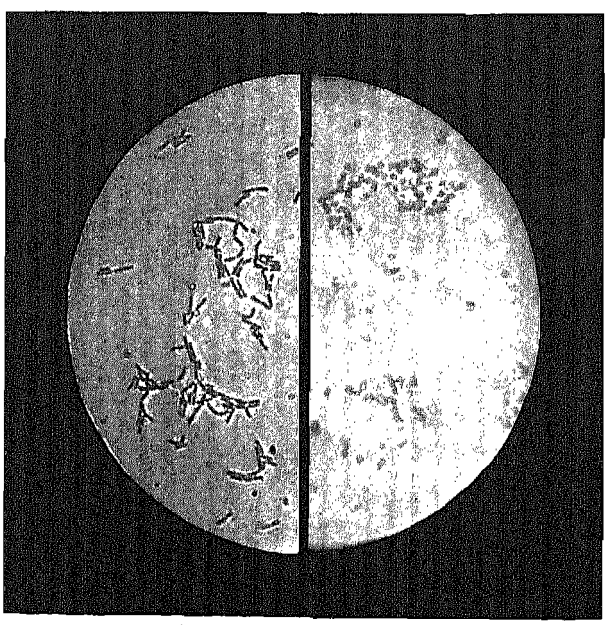
Enzymes

Enzymes are responsible for many changes in foods, though these changes are sometimes so obscure it is difficult to determine their true cause. Enzymes are complex chemical substances, existing in all plants and animals, which have the power to change living matter without being affected themselves. Now, not all these changes are necessarily deteriorations, but they often lessen the value of a product as food for man. In plants, for instance, enzymic action generally brings on the next step in the growing process. The sprouting of grains and seeds and peas and beans are examples of this. Sprouted grain does not make good flour, and peas that have begun to grow do not have a fine fresh flavor. Color changes in fruits and vegetables are often brought about by enzymic action, too. When a cut apple turns brown or a bruised mushroom blackens, enzymes in the food along with oxygen in the air have induced these changes. Enzymes make important changes in flesh foods, too. When an animal or a bird or a fish is killed, a softening of the flesh due to enzymic action soon takes place. You may have read how the English hang up a side of game in a cool cellar to ripen. They are just taking advantage of the softening action of enzymes when they do this. Eggs and milk and butter are liable to enzymic action, too, though other agents frequently start working first and spoil the food before enzymes have a chance to act. Fortunately enzymes are easily destroyed by cooking food in water at 150 degrees Fahrenheit. They are also checked by drying and refrigeration and so are fairly easy to control.

Microorganisms

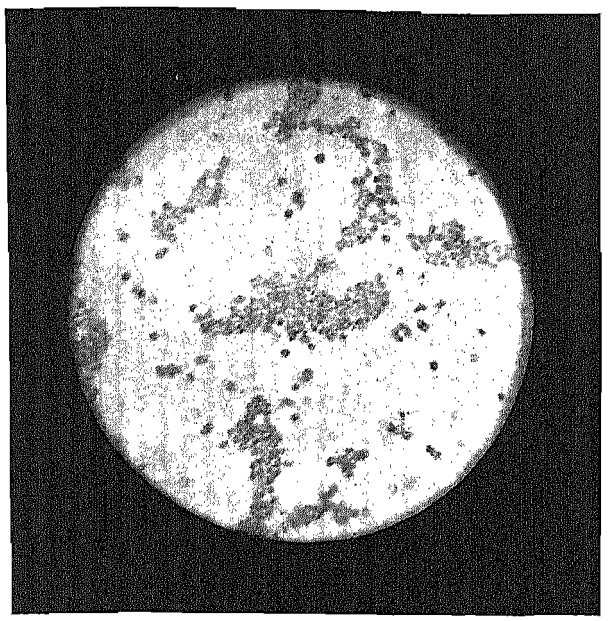
Microorganisms destroy more food than all the other spoilage agents put together. Some of these microorganisms are the tiniest living things in the world, so tiny you can only see them by looking through a very powerful microscope. Then you will see they are little one-celled or many-celled creatures with very simple habits. But these habits are so important man could not live on earth without them. For microorganisms are active everywhere, in soil, water, air, and all organic things, busily decomposing dead plants and animals. This decomposition breaks matter down to the chemicals from which all things were originally formed, returning these elements and compounds to the air and soil and water so they can be used again for new vegetable and animal life. Without microorganisms to do this clean-up work the world would soon be cluttered with refuse and dead plants and animals, and the supply of chemicals so necessary to new life would be exhausted. So you see they are sometimes very useful to us.

Now, since these microorganisms live everywhere, we find them in our food. Here they



BACTERIA (MAGNIFIED ABOUT 2000 TIMES)

may have a good or bad effect depending on the kind they are. Some microorganisms ferment beverages, raise bread, and cure cheese. Others do great damage — spoiling meats, sour-

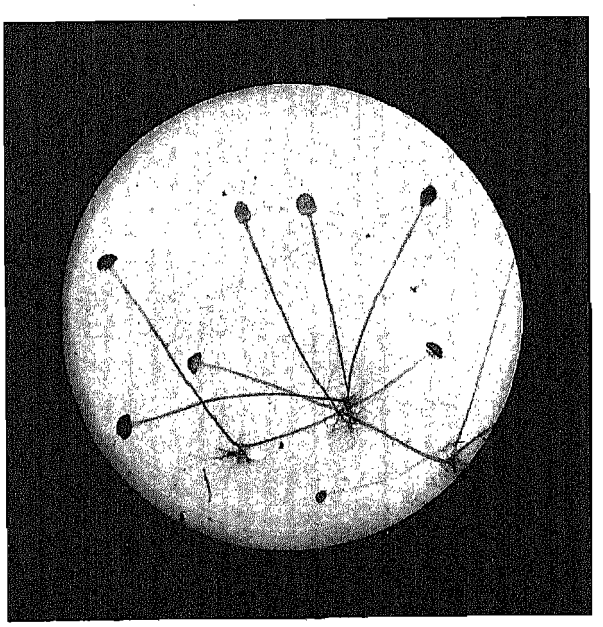


YEAST (MAGNIFIED ABOUT 2000 TIMES)

ing milk, molding bread, and rotting our fruits and vegetables.

The most active of all the microorganisms and the most difficult to control are bacteria. They may affect, either directly or with the aid of other spoilage agents, almost all our foods. Under ordinary atmospheric conditions these bacteria multiply very rapidly so that a whole new family may grow from a single cell and spoil foods in just a few hours. Some of them are remarkably resistant, too. While they cannot stand a very hot, or very dry, or very damp environment in their every day state, they can, when conditions become bad, shrivel into tinier cells with hard outer shells that protect them from the weather. In this state they are called spores. Now these spores may lie dormant for a long time and not take any food or reproduce at all. But they are still alive and when favorable conditions return they can go back to their normal state and start growing new families again. So you see how hard it is to destroy bacteria. In their active state bacteria can be killed by heating to temperatures lower than the boiling point of water. But those hardy little spores take several hours of boiling, or they must be cooked for a shorter time at much higher temperatures than the boiling point of water, to be destroyed. Low temperatures will check the growth of bacteria, but this lasts only as long as the foods are kept cold. When the temperature is raised most of the bacteria return to their active state and spoilage starts again. Dried foods are affected in the same way. As soon as moisture is returned bacterial action begins.

Millions of little one-celled yeast plants float around in the air, dropping in our foods, and causing constant trouble. When food is left standing uncovered, yeasts are very likely to fall in and start fermentation. Have you ever tasted cider that has begun to "work" and is turning hard? Then you will understand the effect these yeast plants have in fruit juices. First they turn the natural sugars and starches in the juice into alcohol so that it becomes hard



MOLDS (MAGNIFIED ABOUT 500 TIMES)

cider. Then they convert the alcohol into acid and you have vinegar. That, you see, is how cider vinegar is made from apples. This same process has been used since very ancient times in making wine from grape juice. Yeast has also been used for centuries to make dough raise in baking bread. Yeast plants multiply very rapidly by a kind of budding process in which a young cell grows out of the side of the parent cell and splits off when it is mature. These cells may also develop into spores capable of becoming entire new colonies. On the whole, yeasts are much easier to control than bacteria, for a few minutes of heating at 150 degrees Fahrenheit is generally enough to destroy them.

You know the damage common mold can do to food. You have probably seen spots of blue or green mold on a loaf of bread, a jar of jam, or a piece of over-ripe fruit. Mold spoilage is much easier to understand because you can see the velvety patches of mold without a microscope. These patches are made up of tiny filaments like the branches of a tree with roots that grow down below or on the surface of the food. Some filaments grow spore cases at their tips like little fruits. In a short time these cases drop off and scatter their spores over the surface of the food. These spores will then begin to grow into many new plants. And so the mold spreads very quickly and destroys the food. The little branches or filaments are white and the spore cases are colored. If the spore cases are blue or green or brown the whole patch of mold will appear to be that color, too. Mold cannot grow without moisture. That is why we have more trouble with foods molding on a damp day than in dry weather. So the best way to avoid mold is to store foods in dry places, closed containers like the bread box or the refrigerator where the atmosphere is dry and the temperature is cold. Molds are destroyed by heating at temperatures below the boiling point and so are not difficult to control by cooking.

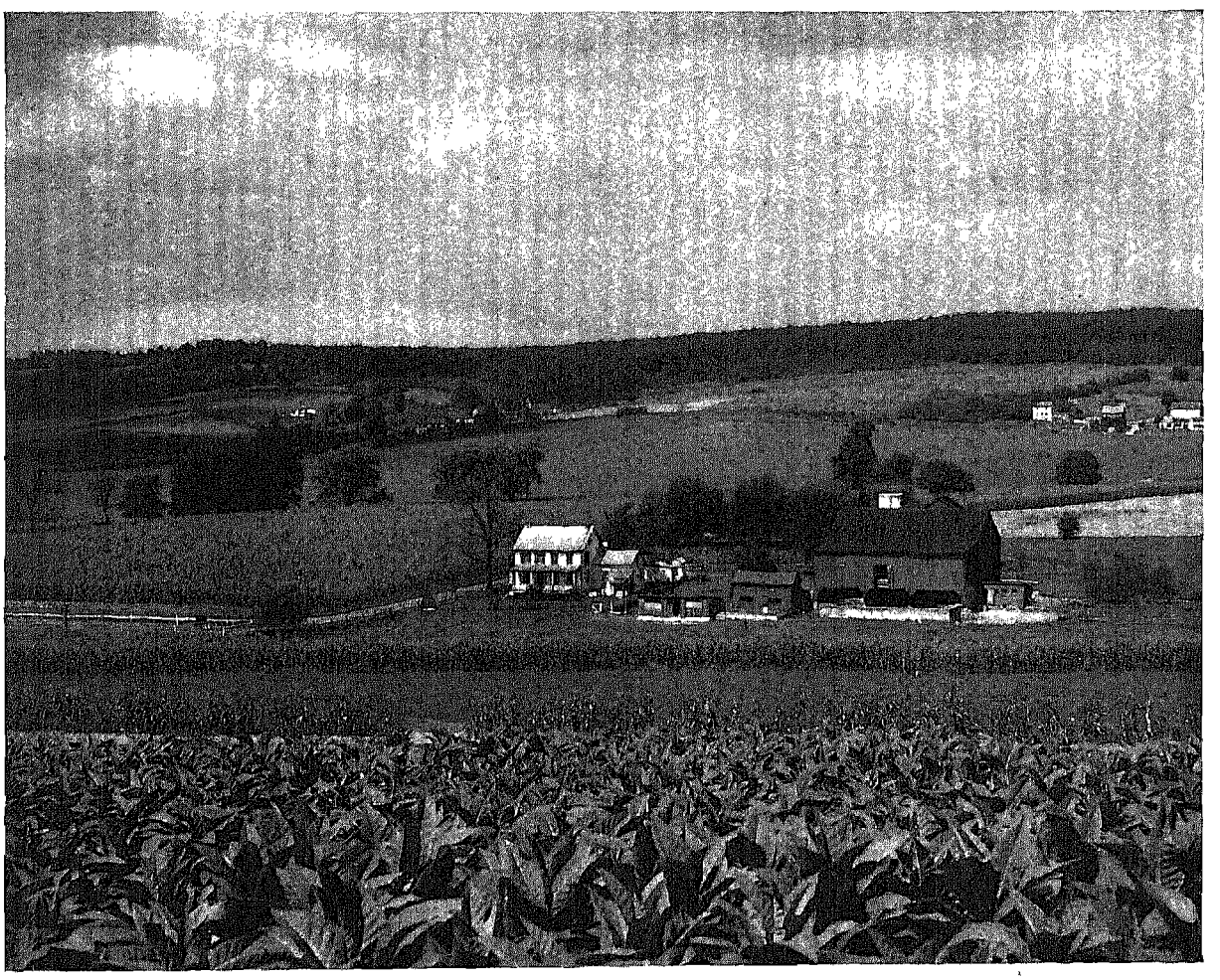
As we have already seen, microorganisms will attack almost all food substances if they have the right conditions of moisture and temperature. Dry grains are not easily affected by any of the microorganisms, but as soon as water is added to them, or if they are stored in damp air, they will begin to soften and start molding. Baked goods like bread and cakes and pies and cookies mold very quickly and must be stored in dry places to be protected. Fresh vegetables contain a great deal of water; so they are attacked rapidly by all three types of microorganisms.

All kinds of fruits, fresh and dried, must be protected against molds and yeasts. Fresh meat is not bothered much by molds and yeasts but must always be protected from bacteria. Salted meats are attacked by molds, but well-smoked meats and fish are safe from all forms of microorganisms when they are stored under proper temperature conditions. Milk is attacked quickly by bacteria and must be handled with great care to avoid being spoiled by them. All of these microorganisms — bacteria, yeasts, and molds — are a serious problem to us in keeping our foods at home. But these microorganisms are of even greater concern to the canner, for unless they are controlled perfectly, successful food preservation is not possible.

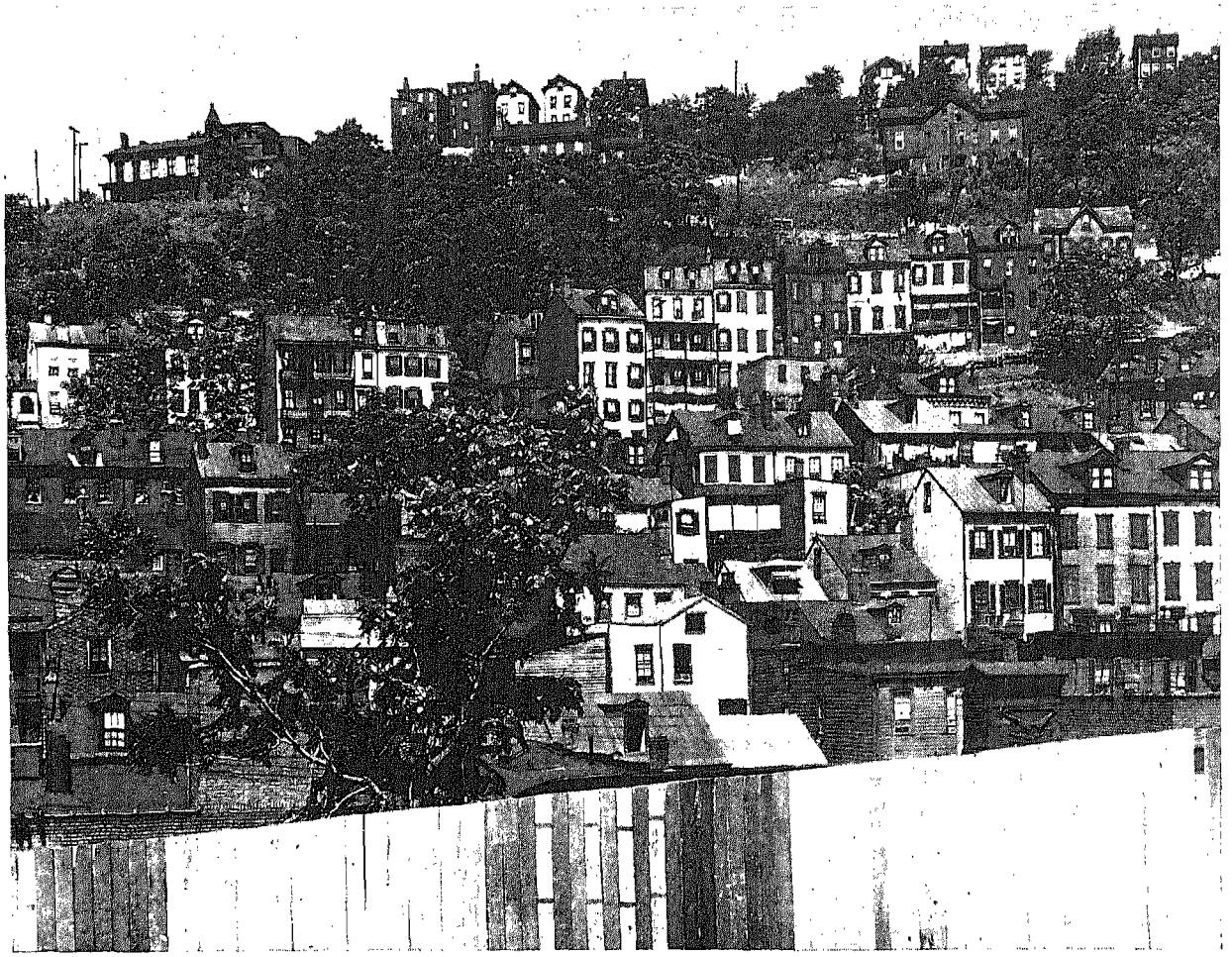
II. How We Preserve Foods

A long time ago, before people crowded together in great cities, food preservation was not as important as it is today. Then most families produced all the food they needed right on their own farms. There was fresh food aplenty all during the growing season with a surplus left to store for winter. Fields and gardens yielded grains and vegetables and fruits. Cows grazing in the pasture supplied milk and cheese and butter. Every farmer butchered his own cattle early in the winter; every farmer's wife had flocks of ducks and geese and chickens. Out back, behind the farmhouse, a little red brick smokehouse held sides of beef, fragrant hams, and bacon flitches hanging from the rafters. Down cellar the big briny pork barrel was filled with hocks and ribs and shoulders.

There were jams and jellies in the pantry, and frozen pies and puddings stacked up on the side shelves in the buttery during the winter. Bundles of dried herbs and ears of pop corn



OLD-FASHIONED FARM



A BUSY CROWDED COMMUNITY

hung from the low rafters in the attic. Down in the cool springhouse crocks of milk and firkins filled with butter stood on the damp stone floor. The root cellar, tunneling into the hillside, was lined with bins of apples and boxes of onions, potatoes, cabbages, and turnips. Some farms even had an icehouse built beside a shallow pond, where blocks of ice were cut and stored in winter. You see, a family could be self-sufficient in those days. Even in the towns and villages people had gardens at their own back doors and farmers brought fresh produce to sell in stalls and markets almost every day. Then food could be gathered and stored, or sold and eaten before it had time to spoil.

But when many people began to live in busy crowded communities it was no longer possible to supply fresh food for everyone, and the simple means of preservation known at that time were not dependable enough to keep all the food needed for a city. Some foods, like seeds and grains and nuts, could be stored safely so long as they remained dry. Others kept fairly well smoked, salted, or pickled, though these methods of preservation had such strong flavors in themselves they could be used only on certain foods with which their flavors blended.

Cold and ice prevented spoilage in the summertime, but there was no way of making artificial ice in those days and only a few

people could afford to keep natural ice in the city. Certain foods were dehydrated, and they kept fairly well that way so long as the atmosphere was dry, though when damp weather set in spoilage always started. Spices were used lavishly, too, but like all the other preservatives known at that time they merely treated the existing trouble. You see, in those days no one knew that microorganisms were the real cause of most food spoilage. They simply knew that some mysterious form of spoilage soon set in and deprived them of their food. It was not until the era of industrial development and the scientific research that accompanied this growth in the nineteenth century that man learned why his food spoiled and how to prevent this spoilage.

Now that we know how easily food spoils and the number of agents able to induce this spoilage we can appreciate how much the scientists in the food industry have accomplished in developing successful methods of food preservation for us. Until canning was perfected there was no really satisfactory way of keeping foods over a long period of time. For thousands of years men had been trying different methods; some of them were so simple they were part of the folklore of all primitive people; others, more complex, were the products of fairly advanced civilizations. But none proved satisfactory in all climates, and none prevented spoilage for any length of time. All of them are important to us, however, for each represents a step in the development of modern food preservation, and many of them are still being used in much the same way today. Let us examine these various methods and determine their value to us now.

Simple Storage

In the middle of the eighteenth century, when most of America was still a forest wilderness, an eminent Swedish scholar, Peter Kalm, landed on these shores. He had been sent here by the Swedish crown, but unlike many other royal emissaries his mission was neither politics nor commerce. His purpose was to study plant life — the trees and flowers and shrubbery native to this land — and see if they would grow on Swedish soil. Through southern Canada, Pennsylvania, York state, and New Jersey he traveled, collecting plants and seeds and making written records of the things he saw. Peter Kalm was not merely a scientific writer, for he took entertaining notes on many other things he noticed as he went along. He was one of the first commentators on Americana, and his notes, which were published on his return to Sweden in 1751, gave an accurate picture of life in the colonies during this time.

Among the many things which Kalm described were the habits of the common gray squirrels as he observed them in the forests of Pennsylvania. Of them he says:

> The grey squirrels are very plentiful in Pennsylvania and in the other provinces of North America . . . Their nests are commonly in hollow trees, and are made of moss, straw and other soft things: their food is chiefly nuts; as hazel nuts, chinquapins, chesnuts, walnuts, hiccory nuts and the acorns of the different sorts of oak which grow here; but maize is what

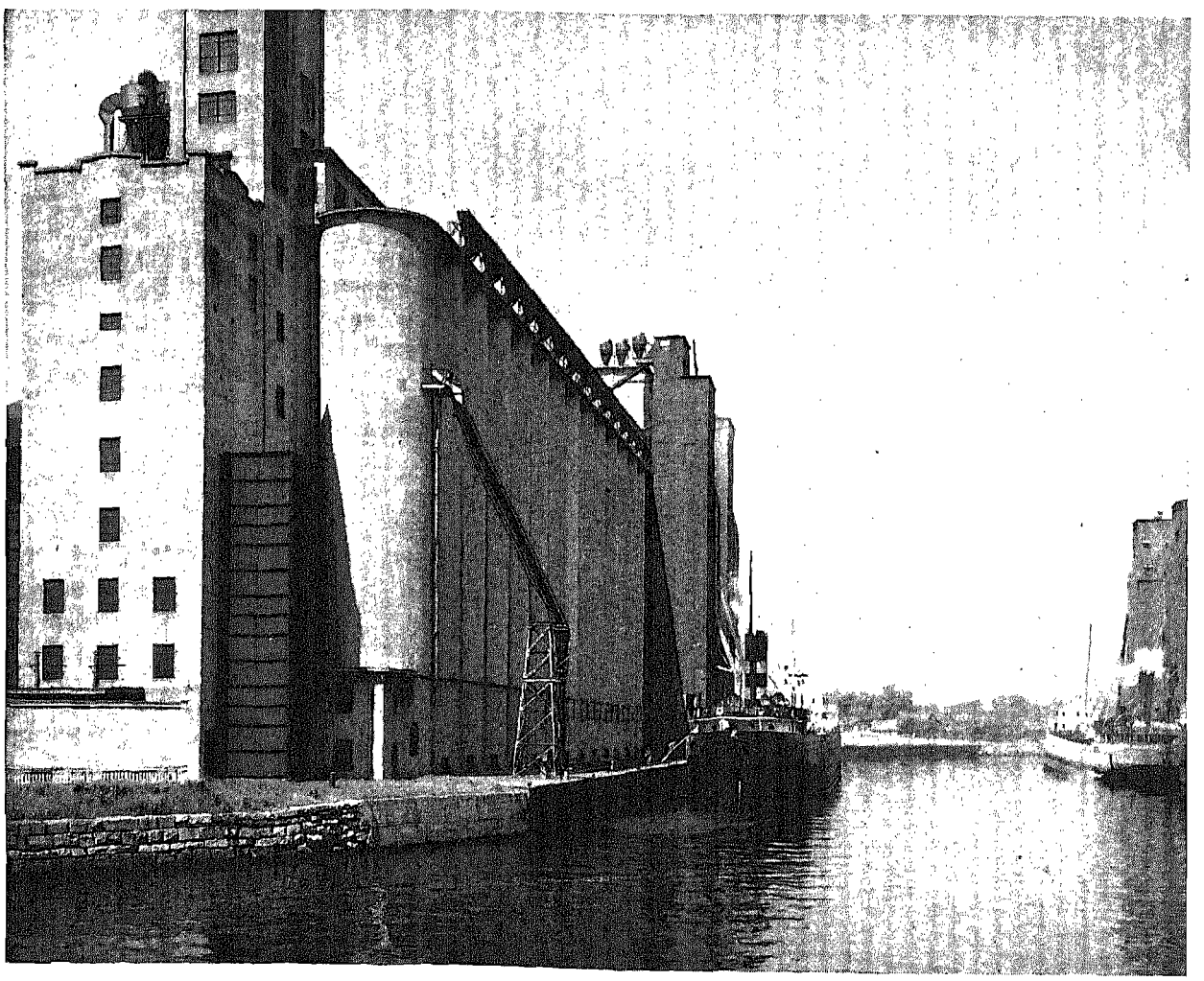
OLD ROOT CELLAR

they are most greedy of. The ground in the woods is in autumn covered with acorns, and all kinds of nuts which drop from the numerous trees: of these the squirrels gather great stores for winter, which they lay up in holes dug by them for that purpose: they likewise carry a great quantity of them into their nests.

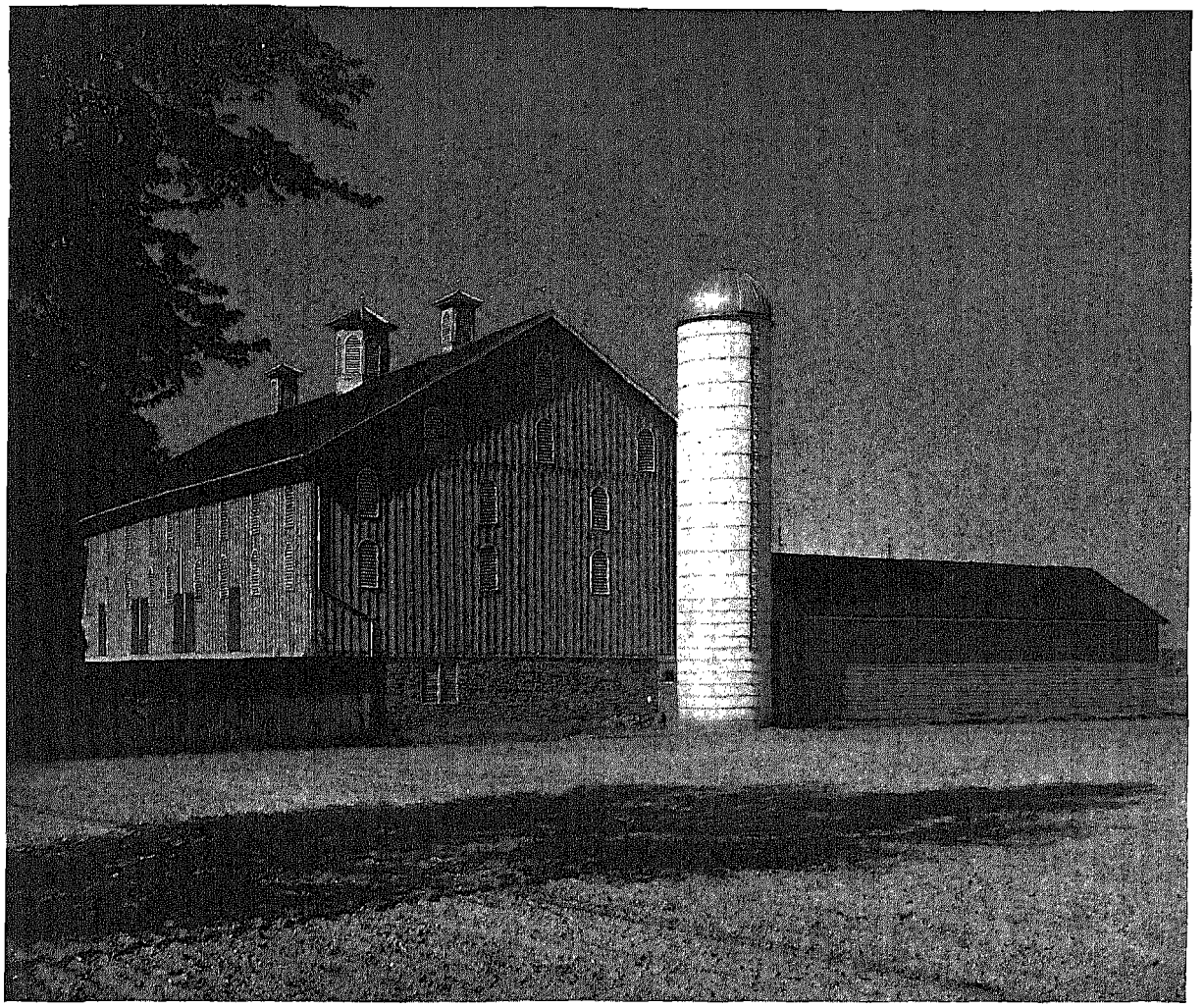
As soon as winter comes, the snow and cold confines them to their holes for several days, especially when the weather is very rough. During this time they consume the little store, which they have brought to their nests: As soon therefore as the weather grows milder, they creep out, and dig out part of the store which they have laid up in the ground: of this they eat some on the spot, and carry the rest into their nests on the trees. We frequently observed that in winter, at the eve of a great frost, when there had been some temperate weather, the squirrels, a day or two before the frost spell, ran about the woods in greater numbers than common, partly in order to eat their fill, and partly to store their nests with a new provision for the ensuing great cold, during which they did not venture to come out, but lay snug in their nests. Therefore seeing them run in the woods in greater numbers than ordinary was a safe prognostic of an ensuing cold.

About chipmunks he writes:

Their food consists of all sorts of corn, as rye, barley, wheat, maize and of acorns, nuts, etc.



GRAIN ELEVATOR



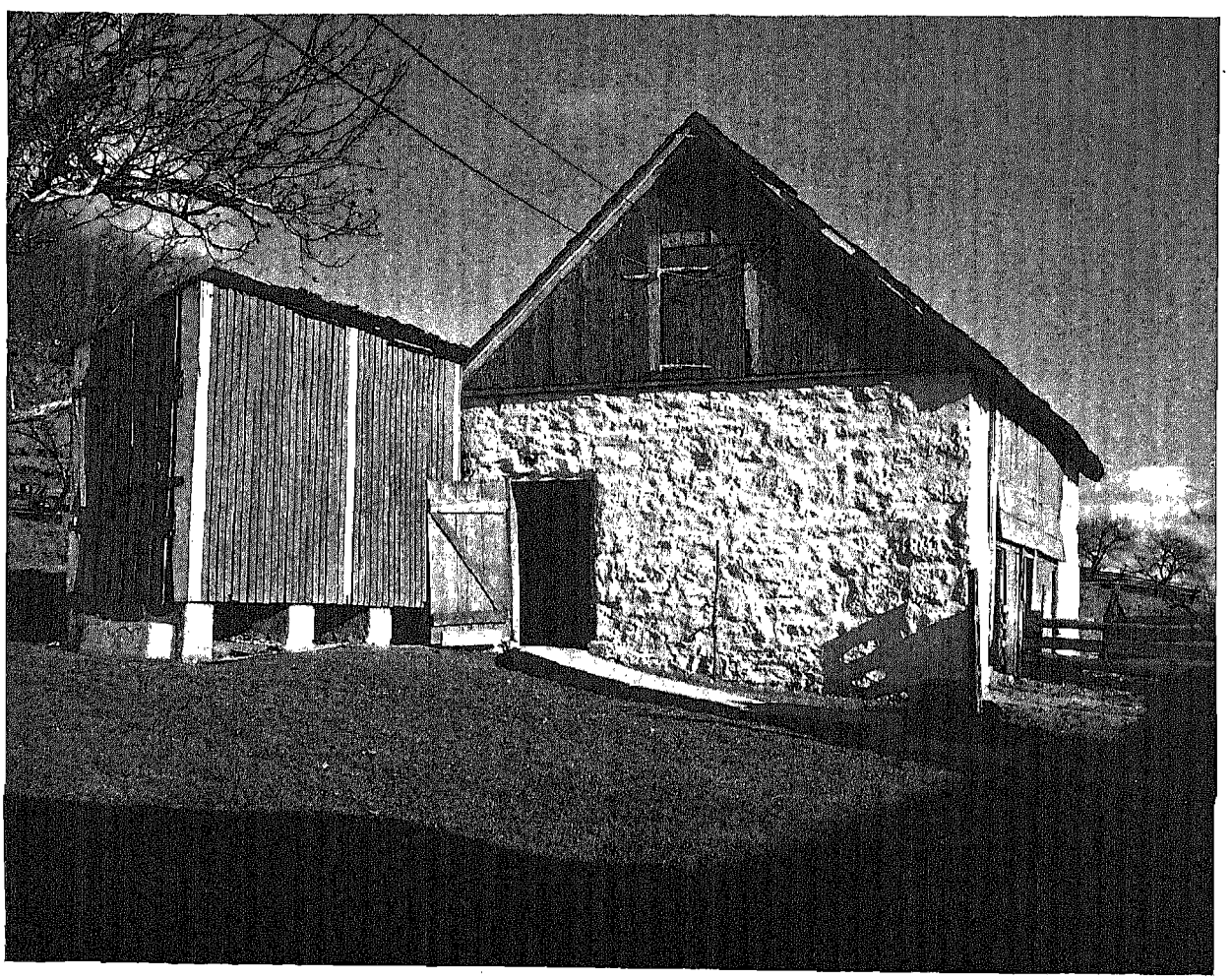
A BANK BARN

They gather their winter provisions in autumn, like the common grey squirrels, and keep them in their holes under ground. If they get into a granary, they do as much mischief as mice and rats. When the maize is reaped in the fields they are very busy in biting off the ears and filling the pouches in their mouth with corn, so that their cheeks are quite blown up. With this booty they hasten into their holes which they have made in the ground . . . As a Swede was making a mill-dyke, pretty late in autumn he employed for that purpose the soil of a neighboring hill, and met with a hole on a subterraneous walk belonging to these squirrels: he followed it for some time, and discovered a walk on one side like a branch parting from the chief stem: it was near two feet long, and at its end was a quantity of choice acorns of the white oak, which the little careful animal had stored up for winter. Soon after he found another walk on the side like the former, but containing a fine store of maize; the next had hiccory nuts, and the last and most hidden one contained some excellent chesnuts, which might have filled two hats.

The method by which these animals kept their food so well is called storage. Primitive man probably learned from animals to store his own nuts and seeds in a hole among the rocks in his cave. At any rate, man has kept his food

this way since very ancient times. Our own methods of storing food today do not differ greatly from those of our remote ancestors. We use more elaborate containers now, but aside from this the methods are still very much the same. You may have seen a row of tall cylindrical elevators towering over the railroad tracks in some Midwestern city. These elevators are storing grain — wheat and rye and barley to be ground later into flour. You probably all have boxes of breakfast cereal and cardboard cartons filled with food on the pantry shelves at home. Though there is a great difference in the size of these containers, both the grain elevator and the cardboard carton are storing food for your future use.

You see, storage simply means putting food in a container without trying in any way to regulate the temperature and humidity inside the container. The container may be a sugar bin, a wooden box, a vinegar barrel, a glass bottle, a cotton flour sack, or a paper bag. Even the earth is used to store foods, for in countries where the climate is cool enough farmers often dig cellars into the hillsides and line the walls with bins and boxes filled with fruits and vegetables, or they pack apples, potatoes, cabbages, and parsnips down in straw-lined root pits dug below the frost line where things will keep cold and firm and fairly fresh.



CRIB FOR STORING CORN (ON LEFT)

Some foods require several kinds of containers before they come to us. Grain, for instance, is stored first in an elevator. Then, it is taken to a mill and ground into flour. And finally it is packed in sacks or cardboard cartons and placed on the grocer's shelves.

Because it is the simplest method, storage is used to keep a larger volume of food than any other type of preservation. All over the world, from savage villages to complex cities, people depend on storage to keep part of their food stuffs. But that does not mean storage is the best method of preserving foods, for foods that are protected by storage alone may be affected by every spoilage agent we have discussed. And so only foods with very good natural keeping qualities can be preserved by storage. Cereals like wheat, oats, rye and barley, and the dry legumes — peas, beans, and lentils — keep well if they are protected from rats and mice and insects. Nuts and oily seeds last fairly well in storage for a few months if they are guarded from molds and rancidity. Edible oils like olive oil and cotton seed oil will keep several months packed in tightly closed containers. And refined and manufactured foods like starch and sugar keep almost indefinitely in storage. But for most other foods simple storage is not enough protection to prevent spoilage.

Harmful Chemical Preservatives

Harmful chemical preservatives were once used widely both in commercial and home canning. You may have seen someplace, in the window of an old-time drug store, a little paper packet labeled "Canning Powders." Your own grandmother often used these powders to help keep the fine foods she put up in the fall. And before scientific methods of food packing were developed, the commercial canner, too, was dependent on the same artificial preservatives: benzoate of soda, borax, formaldehyde, benzoic, and salicylic acid. All of these substances taken in sufficient quantities may be harmful, though neither the home canner nor the commercial food packer rarely used enough actually to be injurious.

After a time, however, these artificial preservatives became very unpopular. Though

THESE CHEMICALS ARE NOT USED IN MODERN FOOD PRESERVATION

they did give almost perfect protection against spoilage agents, they were still regarded as possibly harmful substances in food. Many people were so bitterly opposed to these adulterants they aroused a great public protest which resulted finally in the passage of the first Pure Food Laws. Meanwhile the canners themselves had been experimenting with other methods and they soon learned there really was no need for chemicals — that good foods, properly processed, would keep without the addition of artificial preservatives. Quality packers had been preparing foods for a long time without resorting to adulterants, when Dr. Harvey Wiley, distinguished chief chemist of the United States Department of Agriculture under President Theodore Roosevelt, promoted the first Pure Food Laws in 1907. Progressive food manufacturers welcomed this movement and co-operated enthusiastically with Dr. Wiley in drafting and enacting these laws.

Nowadays the presence of any of these chemicals as preservatives in foods generally

indicates unsound manufacturing methods. For a time some packers still thought that small amounts of these chemicals could have no actual harmful effect, but medical and health authorities insisted no food should contain any preservative substance that might be the least bit harmful to the consumer. So when any of these preservatives are present now, federal law requires the manufacturer to list on the label the names and the amounts of chemicals used.

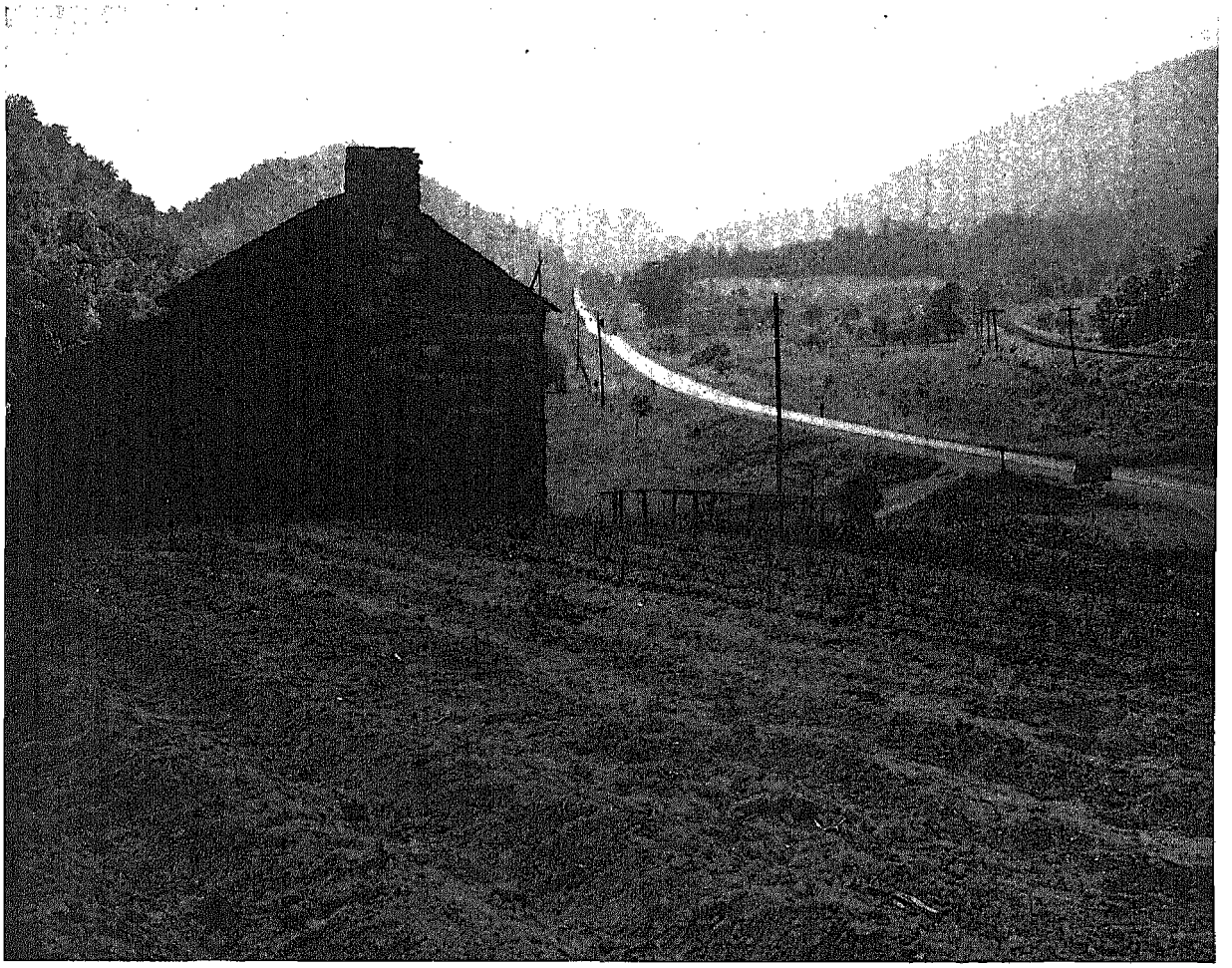
Harmless Chemical Preservatives

Salt and vinegar, sugar, wood smoke and spice have been used to keep foods for so many centuries no one knows their origin as preservatives. They are such a common part of our diet nowadays we are apt to think of them as natural foodstuffs, but as a matter of fact, all these substances are as truly chemical as the artificial preservatives we have just discussed. But unlike the harmful chemical preservatives, salt and vinegar, sugar, wood smoke and spice are quite harmless substances that not only enhance the flavor of the food they are preserving but in some cases even add to the nutritional value. Of course it is necessary, since these preservatives all have pronounced flavors of their own, that they be combined only with foods with which their flavors blend. This limits their use to a considerable extent. You see, meats might be preserved adequately with sugar and fruits probably would keep well enough if they were smoked, but neither of these combinations would be pleasing to us from a flavor standpoint. We prefer the pungent savor of smoke on meat and the delicate flavor of sugar with our fruits.

At one time this class of preservative was used much more widely than it is today. Salting, pickling, smoking, preserving with sugar, and spicing were among the very few ways man knew to keep his food for any length of time. In order to be effective, however, all these preservatives had to be used in very concentrated quantities which left strong and sometimes unpleasant flavors in the food. For this reason, as soon as milder methods were developed, these stronger substances were used less as preservatives and more often as flavorings until today we think of them chiefly as seasonings and spices on the pantry shelf and in the condiment cupboard at home. But there was a time when each of these preservatives was in great demand and men made heroic efforts to have them for their food. Kingdoms have been conquered, new lands discovered, and priceless trade routes opened to obtain them. Some have played a part in world affairs, and all have been important in men's lives since ancient times.

Salt . . . When Joseph Drake and his Long Hunters followed the Great Warrior's Path through the Cumberland Gap, they came down the western slope of the Appalachians into the Indian land of Kentake. Here was a land of great primitive beauty, but a land so dangerous no Indians dared to live there. For all the tribes throughout this country had some claim upon Kentucky and fought savagely among themselves to make it theirs. The Kaskaskias, the Mohawks, the Cherokees and Chickasaws, Delawares, Piankishaws, Wyandots and Iroquois each believed Kentucky was its own by right of conquest and by treaty. For centuries this land had been disputed by them and had become a dread and bloody battleground.

It was a land of ancient forests — of tulip trees and elms and walnuts, groves of cedar, sycamore and pawpaw, shagbark, oak and beech and maple, chestnut, buckeye, pine and locusts — great trees taller than the eye could see. Here there was no underbrush; the forest floor was carpeted with moss and fern. Beyond the forests were dense canebrakes and endless meadows of wild grass as high as a man's head. Streams and rivers spread out across this fertile land, and a maze of Indian trails



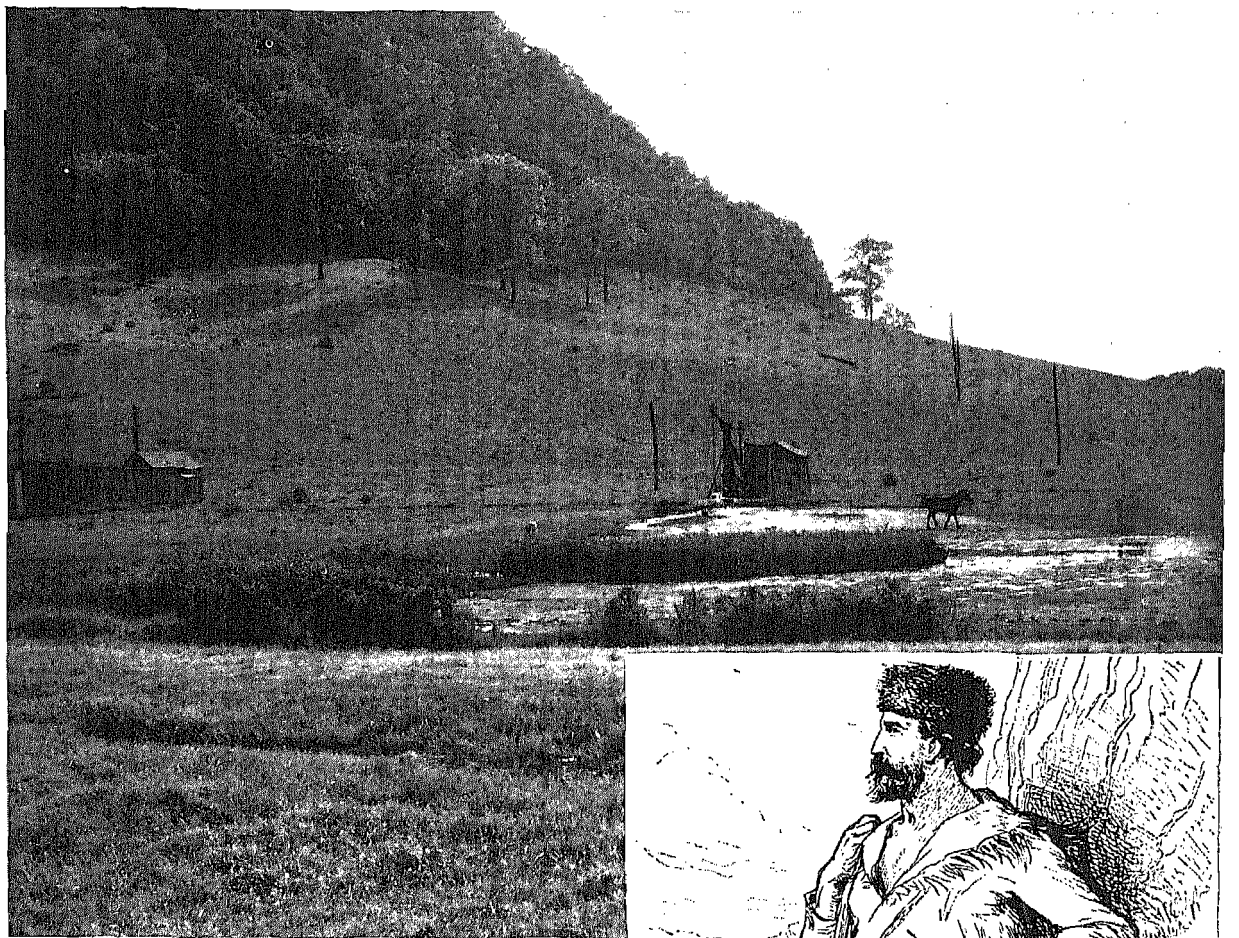
GREAT WARRIOR'S PATH TODAY

threaded all along the waterways, hunting paths and portage trails so slender men could only march in single file along them.

Here game was wild and plentiful — deer and buffalo and elk, bears and beaver, squirrel and foxes. There were turkeys and partridges and geese, ducks and plover, pigeon, snipes, and woodcock. The streams were swarming with fresh water fish — trout and perch, mullets, suckers, eels, and sunfish. And there were fine salt springs and licks where animals came to lap the surface of the soil. Around these licks the early hunters found great bones of extinct animals — bison, mastodon, and many other kinds of game unlike any they had seen before. For throughout prehistoric and historic times these rich deposits of salt and salt springs had attracted animals and men.

Into this land came the Long Hunters to hunt and trap and to explore. Down the rivers and over the trails they followed Indian paths and buffalo traces to the salt licks. Here they camped and built their depots, and it was to these licks they all returned when their hunting trips were done. Salt licks attracted animals and salt gave them the means of keeping their fresh kill.

East through the woods and over the mountains went the word that in Kentucky salt was plentiful. Now there would be no need to go back to the settlements along the Yadkin for supplies. Pioneers could come and bring their



OLD SALT WELLS—SALTVILLE, VA.

axes and their guns, their kettles and their plows and cattle. And so they came, slowly at first, and under the guidance of the greatest hunter and explorer of them all — Daniel Boone. By a salt lick on the Kentucky River Boone built a palisade and established his own town of Boonesborough. Here the settlers hunted and made salt to keep their game. You see, salt making was one of the most important *tasks of the menfolk in the frontier town.* It was tedious and hard to do, for it took hundreds of gallons of spring water to make a single bushel of salt.

This urgent need for salt kept the first settlers in constant danger. In making salt they generally worked out beyond the fort

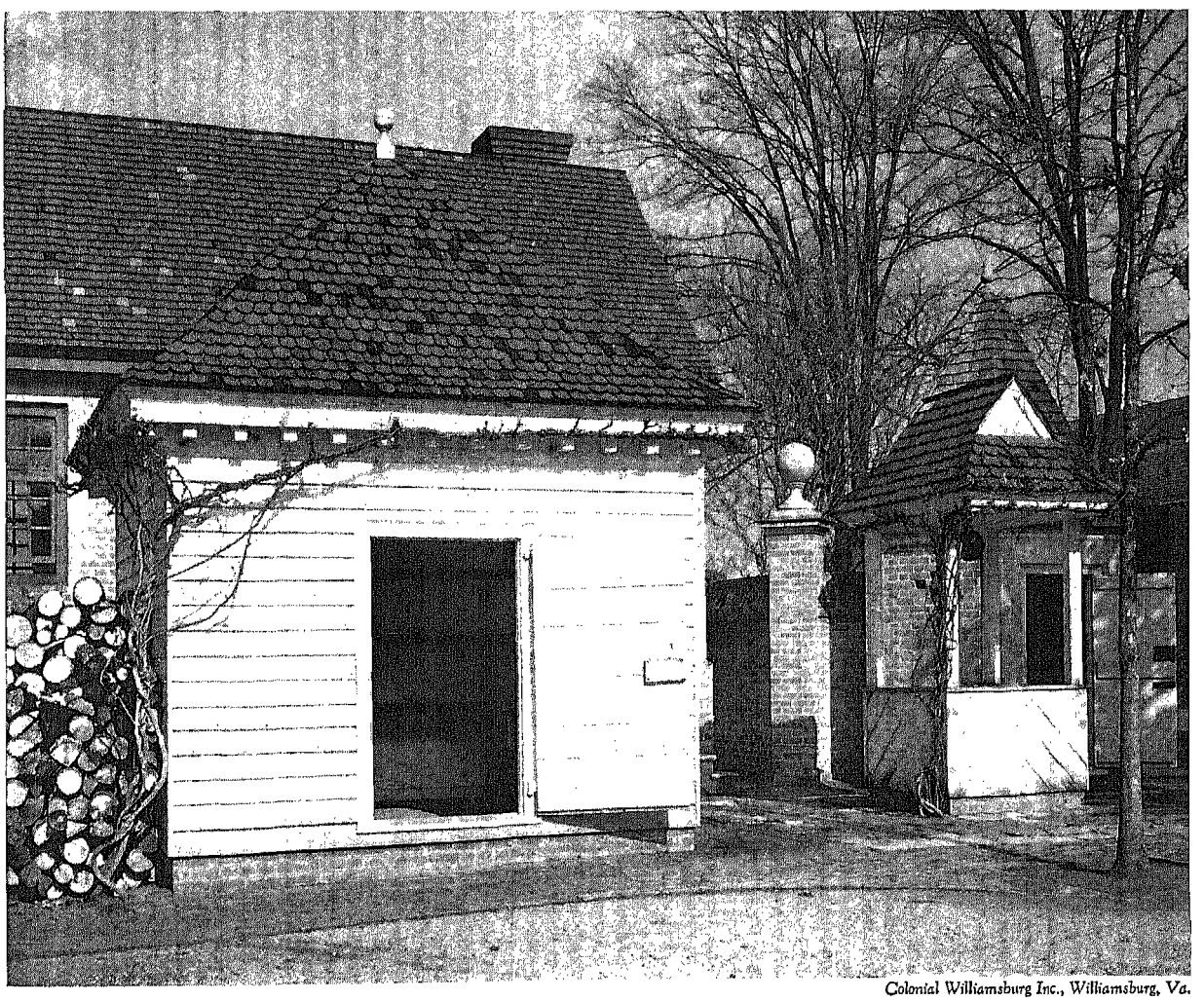
Darlington Library, University of Pittsburgh

DANIEL BOONE

where they ran the risk of Indian raids. They went on frequent expeditions into other parts of the country, too, searching for salt deposits and marking the sites for future settlements. Boone himself was captured once along with twenty-seven other men from the settlement when they were making salt at Blue Lick, and Boone's older brother was later killed by Indians on an expedition after salt. Many of the finest men of the frontier were lost this way searching for salt or working their deposits.

Today we can scarcely understand the importance of salt in the pioneer period, for so many new methods of preservation have supplanted salting. But in those days a settlement could barely exist without it, there were so few other ways to preserve their food. The first settlers lived almost entirely by the chase, fishing and hunting while the game was plentiful. In winter, when game was apt to be scarce in the forests, any animals that could be caught were certain to be tough and stringy. So the thrifty frontiersman generally tided over this lean season by bagging an extra supply of game when the hunting was good and packing the surplus meat down in salt to save for winter.

The early farmers who followed these hunter-pioneers into the forests counted on



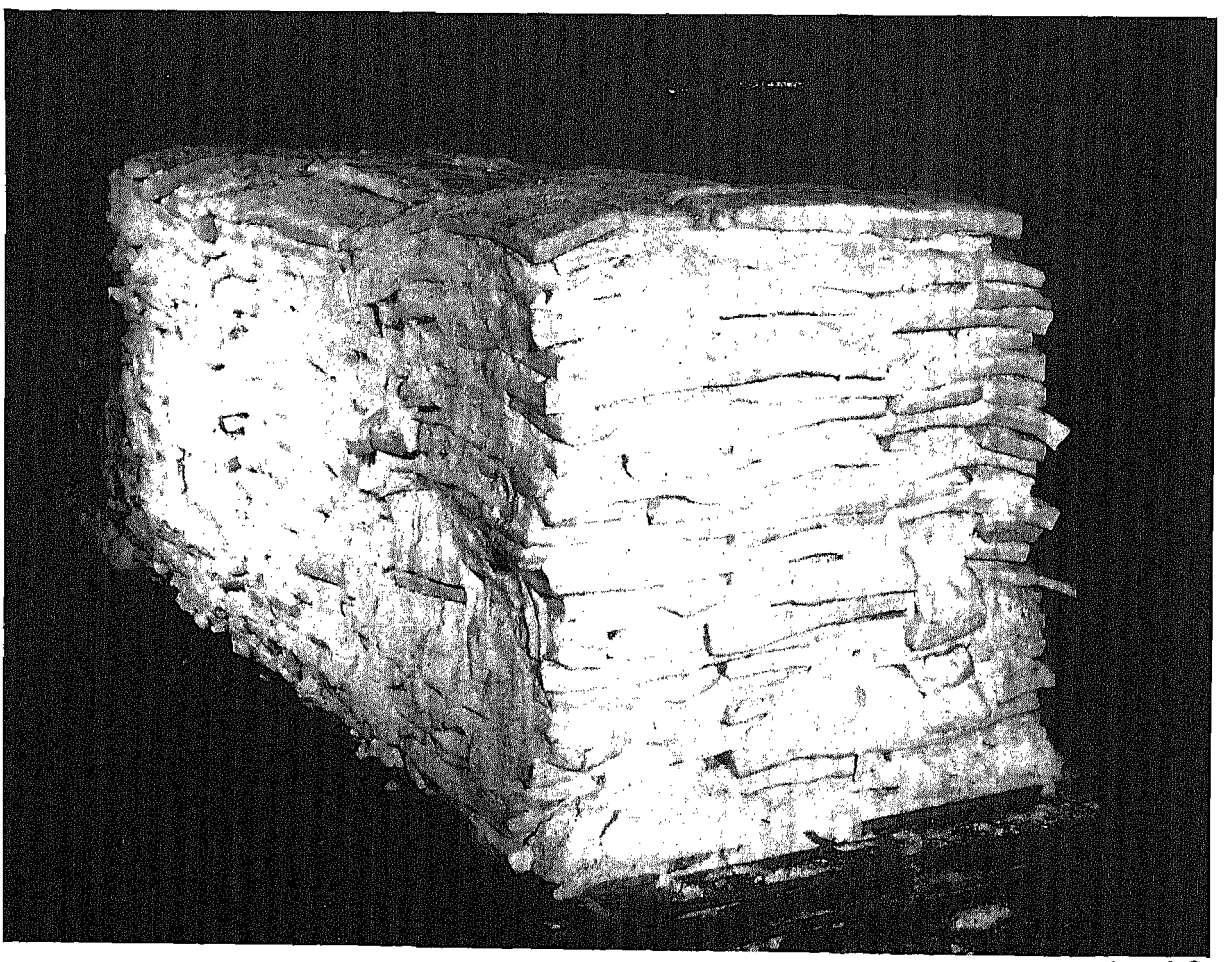
Colonial Williamsburg Inc., Williamsburg, Va.

HOUSE FOR SALTING MEAT

salt to keep a great part of their food, too. Now they no longer depended on the chase but raised their own hogs and sheep and cattle. With salt to cure his meat a farmer could butcher almost any time and save the extra cuts from spoiling by packing them down with salt in big boxes or barrels. Often a farmer found he was not going to have feed enough to keep his cattle through the winter. With salt he could butcher early, even in warm weather if need be, and store the extra meat or haul it into town to sell and so get full value from his stock.

During colonial days, and even later in many isolated sections of the country, salted meat was the only meat available the whole year round. Every farmhouse had a big barrel filled with brine in which the farmer pickled hocks and hams, sides and shoulders, and all the other cuts he liked to save for winter. Later some of this meat was smoked or soaked in vinegar, but almost every cut that was butchered was steeped in the briny salt barrel first.

Without salt the great packing industry of the Middle West never could have developed as it did. The fine pastures and rolling hillsides of this country were suited to raising larger herds of cattle than was practicable back east. But the markets were too far away to drive all



Armour & Co.

DRY SALTING PORK

Pioneers' Village, Salem, Mass.

MAKING SALT FROM SEA WATER

the cattle needed for these cities, and since there was no refrigeration at that time, it was not possible to ship fresh meat clear across the country. When salt became cheap and abundant in the Middle West, however, it was then possible to butcher many head of cattle for storage and shipment east. Today, of course, artificial refrigeration has largely displaced this use of salt.

The first settlers in this country obtained their salt from sea water. In New England the colonists filled wooden tanks with sea water and allowed it to evaporate a little. This more concentrated solution was then dipped into a shallow stone container on the ground. Then a fire was built in a little tunnel under this container and the water heated to increase the rate of evaporation until a deposit of pure salt was left in the bottom of the tank.

In some parts of Europe, where the salt springs contained too little salt to be worth the cost of fuel for evaporation, water was pumped up to the top of a scaffold filled with brushwood and allowed to trickle slowly down, evaporating as it ran. After repeating this process several times, the water was concentrated enough to be worth evaporating further over heat. In cold climates like Russia, shallow pits were dug along the shore in which sea water was allowed to freeze until a good part sep-

arated from the salt and formed pure ice. This ice was then removed, leaving a very concentrated salt solution in the bottom of the pit, which was then evaporated into dry salt over fire. In much warmer climates the sea water was run slowly through a series of shallow pits where it evaporated until a strong solution was left. Later this was placed in a reservoir and allowed to evaporate further until nothing remained but deposits of pure salt.

In this country a supply of salt was assured along the coast where there was sea water. But inland it was a different problem. The first settlers who went westward had to depend on importing salt from the east or on finding salt licks and springs of their own to work. Often they had none of the equipment needed to make salt or they could not manufacture enough to supply their needs. Salt making was a heavy, time-consuming task. Gallons of spring water were poured into iron kettles; then the kettles were set in a row over fires built in a long narrow pit. Kettleful after kettleful of this water was heated and evaporated to make even a little bit of salt. Using ordinary salt spring water it took 500 to 800 gallons of water generally to make just one bushel of dry salt. And most of the settlers had to work with household-sized kettles, so you see what a tedious job this must have been.

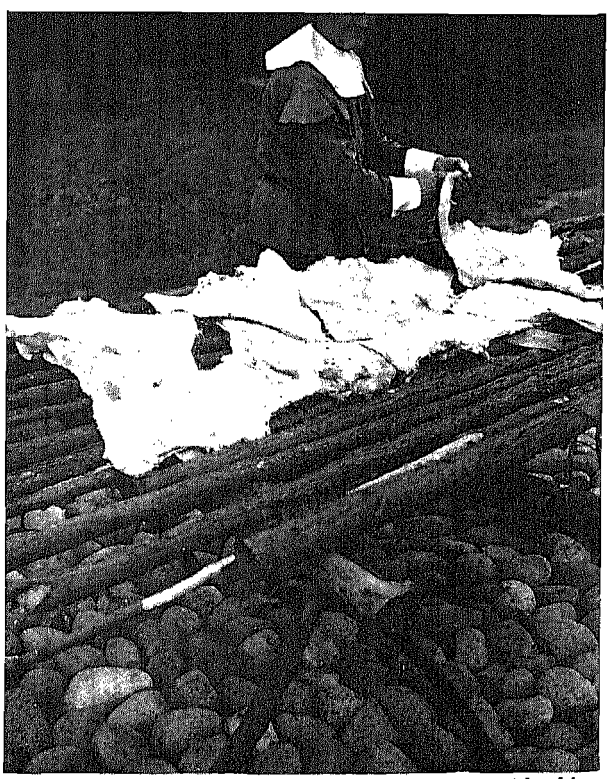
The early settlers soon learned that if a spring contained a fair amount of salt, a well could be dug nearby in which they would find water of much higher concentration. The Onandaga works in western New York were among the first salt springs to develop this way into a commercial enterprise. Toward the end of the eighteenth century the Onandaga works shipped salt by boat down Lake Erie into western Pennsylvania. Before this time most of the salt used west of the Alleghenies had been imported from the seacoast, but salt was too heavy a commodity to be transported cheaply in large quantities over the mountains, so it was generally scarce. Shortly after this the Kanawha works in western Virginia were opened up and it became possible to ship salt from there at much less cost up the Ohio River into western Pennsylvania and the Ohio Valley.

After the War of 1812 salt wells were dug in the Kiskiminetas-Conemaugh Valley; then good salt was easily available throughout the whole early western country. In 1808 the Kanawha works drilled through rock to a depth of 26 feet and a much more concentrated solution of salt water was discovered. Finally wells were extended 100 to 200 feet down where the water was so concentrated 50 to 70 gallons made a bushel of salt. The process was simplified further by manufacturing kettles large enough to hold from 150 to 200 gallons of water. In time, great underground deposits of rock salt were discovered, which are still being mined extensively today with modern machinery.

No one knows who first discovered it, but salt has been used as a preservative since very ancient times. With salted meat to guarantee their food supply, whole tribes could move across a land. Armies on the march used to live mainly on salted meat and stale bread, and ships sailing across the seas carried a store of heavily salted meat with them for food. This meat was preserved in such a concentrated solution it was much too strong to be eaten before some of the salt had been washed out. In medieval times the meat was unsalted in a big barrel called a steep tub lashed to the stern quarter of the ship. The bottom of this tub was perforated with holes through which a stream of water could trickle. To make it edible, pieces of this salted meat were packed in the steep tub, and several buckets of water were poured over it. Then a barefooted shifter was sent over the side of the ship into the barrel to tread hard and force the water through until it trickled out the bottom taking the excess salt with it.

As a preservative, salt has always been used to keep foods with a high water content — juicy foods like meat and vegetables and fish. You know how easy it is to dissolve salt in a glass of water. Well, the same thing happens when you add salt to food. The salt is dissolved by the moisture in the food and is carried by these natural juices through the fiber of the food in a very short time. Food saturated with salt in this way is well protected from most spoilage agents. Microorganisms cannot develop in it and animal and insect pests are repelled by it. Very small amounts of salt will stop the growth of microorganisms, though from 8 to 25 per cent generally is used nowadays.

At one time salt was used to cure almost every kind of meat, domestic or wild. Cabbage prepared as sauerkraut was the commonest vegetable preserved with salt. This was done by packing shredded cabbage in salt until it fermented, changing the brine from time to time during the process. Many fish caught in oceans, lakes, and rivers here were salted, too, and kept for winter when the streams were frozen over.



Pioneers' Village, Salem, Mass.

DRYING SALT FISH

Salt was once used for preserving almost all our foods, but nowadays we use it chiefly in preserving some meats and fish. Dry salt is spread in layers on the surface of the food to be preserved or else the meat and fish are soaked in brine. In either case the salt is absorbed very quickly by the food. While salt is used in making butter, it is not really a preservative, though it does add somewhat to the keeping qualities. On account of their high water content, vegetables are specially well suited to salt preservation. But a strongly saline taste alone is not pleasing to us anymore, so vinegar is usually added and the vegetables are prepared as pickles. Cucumbers, cauliflowers, and cabbages are generally salted first—then steeped in vinegar to make relishes.

Vinegar . . . Early in the last century, before the land was opened much beyond the Alleghenies, an almost legendary figure, Johnny Appleseed, made his way alone across the mountains. Much of York state was unsettled, and western Pennsylvania was prey to Indian raids. The great forests of Kentucky were bloody battlegrounds, and Ohio was still a favorite hunting range of the Red Man. Throughout this wild country, on Indian trails and buffalo traces, down rivers and streams and rough pioneer roads Johnny Appleseed traveled alone with his mission. His head was covered with a mush pan in which he did his cooking. His clothes were made of burlap bags patched and sewed together. Even in the winter weather he often trudged the trails barefooted. Folks said Johnny Appleseed was queer, but they made him welcome in every settlement and outpost. For in a burlap bag slung over his shoulder he carried a treasure of

more value than gold. A treasure in apple seeds. Apple seeds enough to provide all the territory with trees. You see, the apple was not native to this land and the seeds had to be imported and planted carefully to grow. That was Johnny's mission — to plant thriving apple orchards throughout the whole Ohio Valley.

At first he started with a nursery of his own in Pittsburgh. When these trees began to bear fruit he planted their seeds all through the valleys and the mountains, wherever they would grow. If his seed supply ran low he stopped by cider presses and re-stocked his bag to plant orchards further on. Deeper and deeper he worked into the frontier country until he came to land where no white men had ever been. But that did not deter him. If the land was good he turned the soil up just the same and planted seeds. Then he built a brush fence around the little nursery to keep wild animals from trampling his tiny trees and left them alone to grow. Many nurseries were planted this way before the land was even settled, so that when people moved on west and claimed their farms they found thriving apple orchards waiting for them there. When people could afford to, they paid him for their trees, but the first settlers were mostly poor folk; so Johnny never pressed them for his money. It was a matter for each man's honor and Johnny Appleseed went on about his mission.

It is hard for us to understand how much an apple orchard meant to people in those days. The first settlers were busy just trying to keep themselves alive. They had to clear great forests off their land before crops could be sown, build rough log houses for their families, and throw up some sort of shelter for their cows and horses. At first there were no crops at all, and the farmer and his family had to live on the small supply of grain brought west with them. For extra food they had to hunt and fish and gather berries from the forests. So you see why these orchards seemed like a treasure to the settlers. The trees took little tending and did not use up labor needed for clearing land. And in this rich new soil they bore abundant crops of fruit that could be used in many ways. The raw apples added a fine fresh fruit to the frontiersman's meager diet. Then they could be baked, stewed, roasted, or even dried out in the oven and threaded on strings to be stored for winter.

They could be pressed for cider, too, or boiled down into spicy apple butter that would keep well throughout the winter and add a savory flavor to the simple meals. All during the fall season cider was a staple drink along the frontier, but it was of even greater value to the early settlers when it was allowed to ferment and turn to vinegar. Vinegar was nearly as important as salt in pioneer country. Salt was often difficult to find, but any man who had an apple orchard had the means of making vinegar to preserve his foodstuffs for the winter. All he had to do was add some "mother" from the old vinegar barrel to the newly pressed cider and the sugar in the cider would change to the acetic acid of vinegar in a short time.

The New England colonists imported apple trees at a very early date, and made the first cider vinegar there along the seacoast. As settlers moved westward this household lore went with them. Over the rugged Allegheny range, down the Ohio Valley to the Mississippi, up along the winding rivers of the western plains, over the Rockies and down the Pacific coast they spread, taking apple seeds in their covered wagons. Soon fine orchards were growing all across the land. And from the abundant fruit these young trees bore, the thrifty farm folk made good cider vinegar. In time vinegar made from apple cider became the standard American vinegar and for many years in remote parts of this big country some people never tasted any other.

Just as the Americans made vinegar from the apples they had on hand, so do other nations brew vinegar from their local products. In the Orient vinegar was once made from honey and the juices of the palm. Where there is an abundance of good grapes, as in France, fine wine vinegar is made. In fact, the name vinegar itself comes from the French word *vin*, meaning wine. England grows plenty of good grain; so a type of vinegar called malt vinegar is commonly brewed there. Because it was made from sour ale, this was once known as ale-gar. In other countries a fine sharp vinegar is distilled from corn and rye and barley malt.

Man has used vinegar in many ways since very ancient times. The Egyptians regarded fermentation as one of the mysteries of life and ascribed great curative powers to vinegar. The ancient Hebrews had two kinds of vinegar which they used as a drink, the sour wine mentioned so often in the Bible and another made from palm and honey. Hippocrates, the father of medicine, prescribed vinegar for many illnesses, and when the bubonic plague raged in Europe during the thirteenth and fourteenth centuries vinegar was used widely as a cure. Ancient alchemists were concerned with the mystery of fermentation and in the

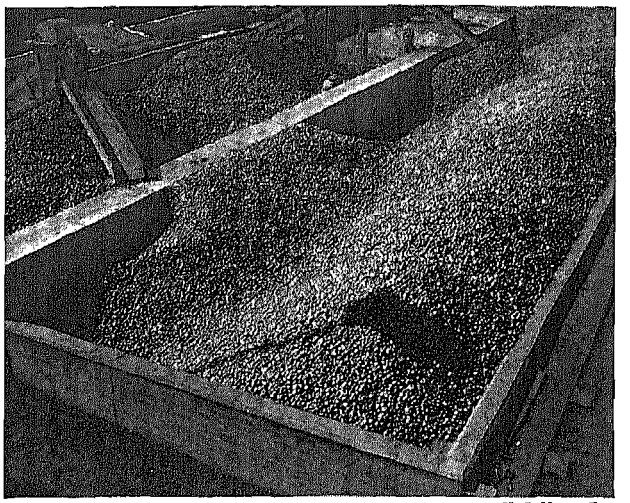
APPLE ORCHARD IN SPRING

course of their experiments with vinegar formulated some of the elementary principles of chemistry as we know them today. At one time vinegar was used also for making extracts of certain drugs. But its most important use has always been as a preservative and flavoring for foods.

Almost all foods can be preserved successfully and harmlessly with vinegar. Only the tart taste of the vinegar itself limits this use. Microorganisms cannot grow in vinegar; enzyme action is arrested; and insects and animals are repelled by its flavor, so that foods preserved in vinegar are safe from most spoilage agents.

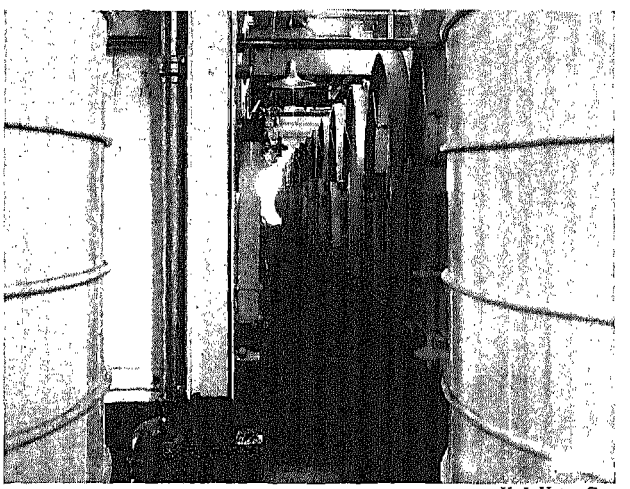
But vinegar is much more than just a preservative. Good vinegar is one of the finest flavorings on our pantry shelves. Sometime you may have tasted a sour vinegar that was little more than acetic acid and water. An inferior vinegar of this sort may be a fair preservative, but it is certain to ruin the flavor of the food it is used with. On the other hand, a choice vinegar, with its piquancy and delicate bouquet, not only keeps food well, but it also heightens the flavor of the food it is preserving.

Like salt, vinegar is most successful as a preservative when it is used on foods containing a large percentage of natural juices. For this reason vegetables are steeped in vinegar after they have been salted. Cucumbers and cauliflowers, beets, onions, tomatoes, peppers, string beans, and cabbages are all pickled this way to give them a fine tart taste and preserve them further. Some fruits are pickled, too, as homemade delicacies, like peaches, pears, and crab apples, but very little preserving of this kind is done now in food factories. Vinegar is a perfectly good preservative for meat, and in the early days in this country people depended on vinegar to keep a good part of their meats, but milder methods of preserving are preferred by most people now. You probably have often tasted pickled fish, as we still prepare some fish



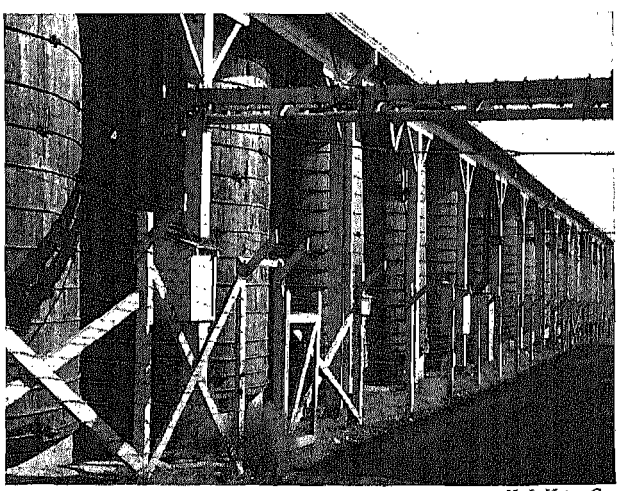
H. J. Heinz Co.

APPLE BINS



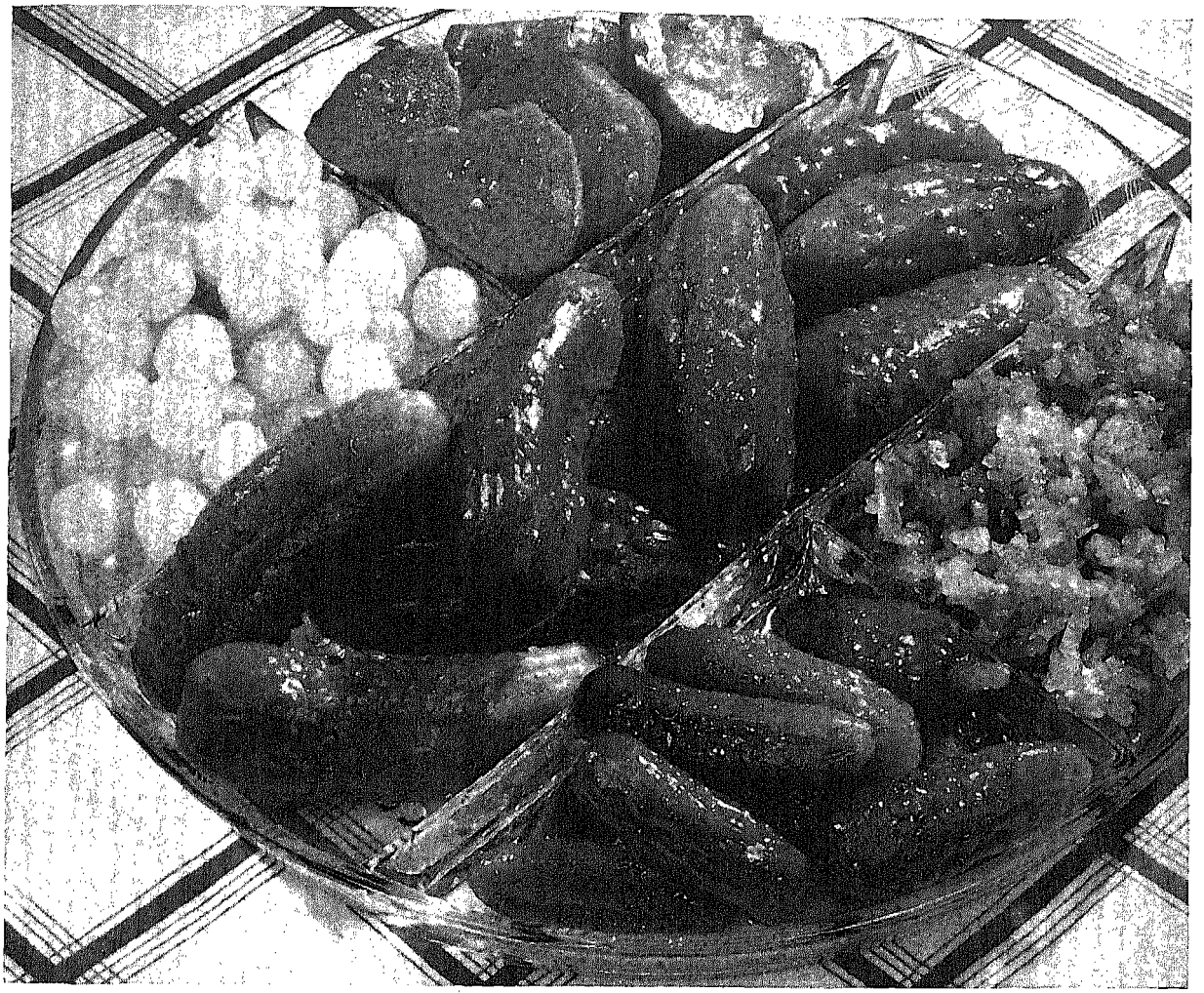
H. J. Heinz Co.

VINEGAR GENERATORS



H. J. Heinz Co.

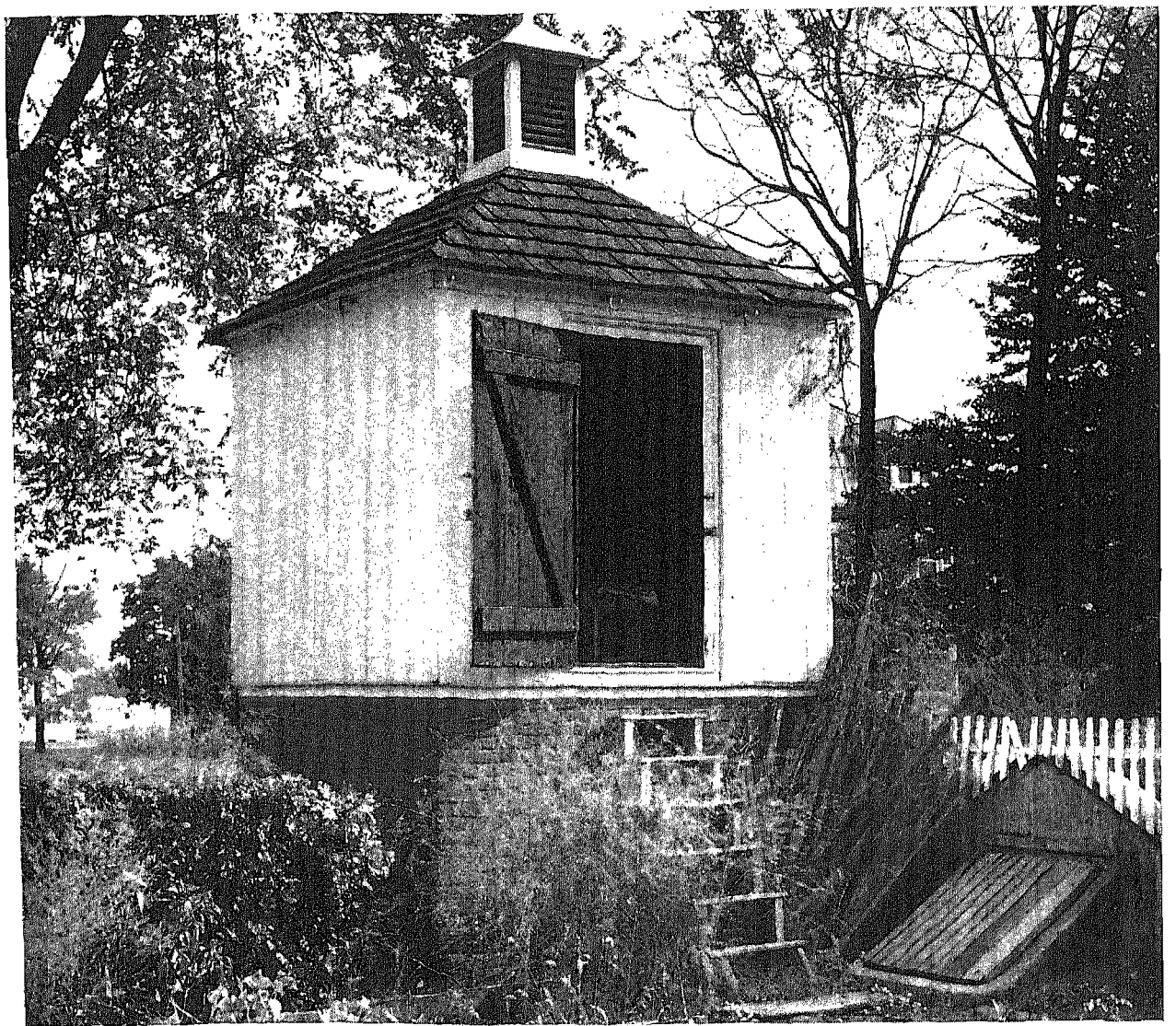
VINEGAR STORAGE



PICKLED PRODUCTS

that way in this country. Pickled herring has a pungent flavor and soused mackerel and Russian sardines are fine prepared in vinegar. When foods like these are done up in hermetically sealed packages, they will keep and retain their full-bodied flavor for a long time. Pickling is an excellent way of keeping foods, and if it were not for modern methods that retain more of the natural flavor we would still have many pickled products in our markets.

Wood Smoke . . . Behind any old-time farmhouse you're apt to see a smokehouse standing in the yard. This is generally a small building shaped something like a tower, with a sharply pitched roof and a narrow door and no windows cut in the walls at all. Sometimes the walls are made of brick, sometimes of stone or wooden clapboarding. Peer inside the door and you will see a bare, dark room with an earthen floor. In the center of the floor will be a hearth, usually built of brick, though it can be simply a shallow pit dug in the ground to hold a fire. There may be a sifting of ashes still on the hearth, or fresh wood for a new fire laid neatly on the ground. Up under the eaves are wooden poles running clear across the room, and hanging from these poles on iron hooks and flaxen loops are sides of beef and bacon flitches, hams and hog jowls, sausages and shoulders.



C. S. Bricker, Lititz, Pa.

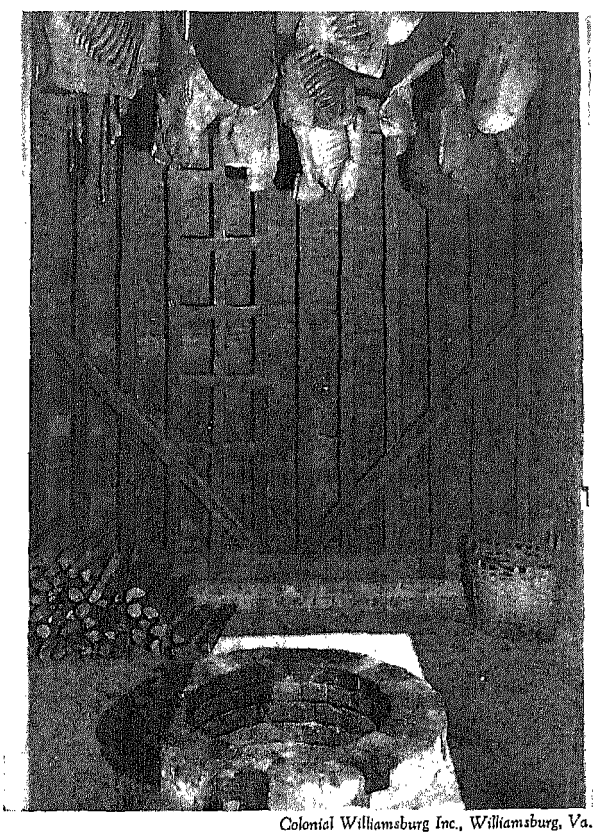
A SMOKEHOUSE

For countless centuries man has been smoking his meat this way. No one knows who first learned how to smoke meat. Probably some primitive hunter dragged home his kill and hung the extra side of game up near the top of his smoky cave to keep for the morrow. As the fire smoldered on the damp stone floor the smoke rose and clung heavily to the meat. Later the hunter found this game had a pungent flavor and better keeping qualities than ordinary fresh meat. And so he tried the experiment again, then told it to his neighbors, until the knack of smoking meat was common to all primitive people.

Until fairly recently smoking, like salting, was a more important method of preservation than it is today. Before the days of refrigeration, quick freezing, and canning, all meats had to be either smoked or salted when the animals were butchered. Fresh meat was only available for dinner on butchering day, or if the weather was cold enough, for a day or so thereafter. In olden times smoking was done more strongly than it is today because the meat

was often held for months and sometimes even years. This was particularly important in the southern states where there was seldom enough cold weather to keep fresh meat for any length of time. So every small farm and great plantation had a smokehouse out behind the big house where the main part of the meat supply was kept the whole year round. Because they were so dependent on keeping almost all their meat this way, southern farmers soon grew very skillful, and developed a method of their own for smoking pork and beef. The lean, long-legged, razorback hogs common to the South, cured and smoked this special way, have made many southern states famous for their country hams and other old-fashioned cuts of meat.

Before meat is ready to be smoked, it is generally cured with salt, to which sugar has been added for extra flavor. Sometimes dry salt is rubbed right into the meat; sometimes the meat is soaked in casks of brine, which, you will remember, is simply salt dissolved in water. When enough salt has been absorbed, the meat is taken to the smokehouse and threaded with a loop of string, or hung on a sharp iron hook and suspended from a horizontal pole up near the roof. Great care must be taken to keep each piece separate from the other so the smoke can circulate easily between them. Before the actual smoking process is begun the meat is allowed to dry out a little more. At first a small fire is built to warm the air and dry the meat. Then a bigger fire is built up, the door is closed, and the smoking process starts. In this closed room the fire burns very slowly, smoldering and making great clouds of smoke which rise gradually and cure the hams.



Colonial Williamsburg Inc., Williamsburg, Va.

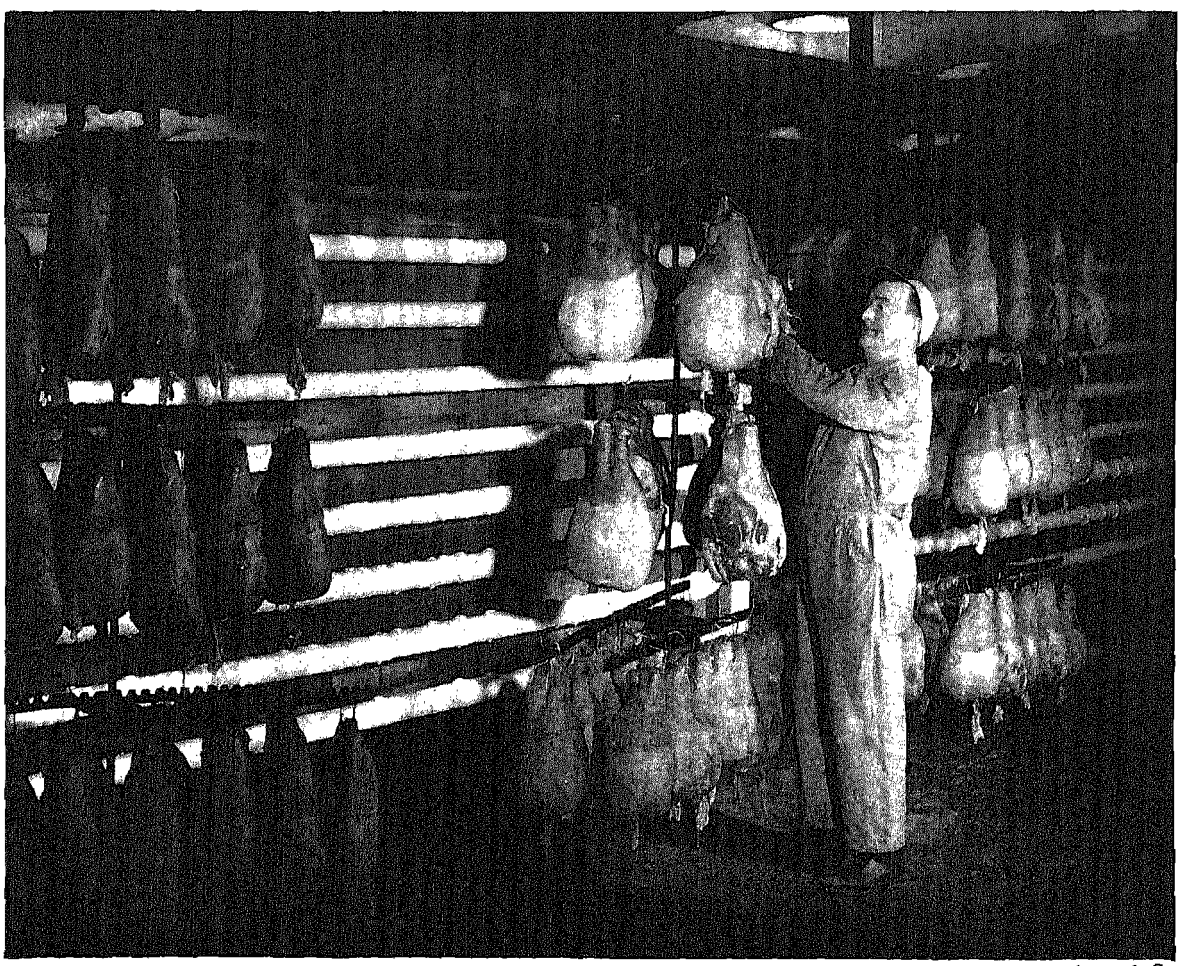
INTERIOR OF SMOKEHOUSE

The penetrating qualities and odor of this smoke vary depending on the type of fuel used for the fire. Hickory, with its pungent-smelling smoke, is a favorite with American farmers although many other kinds of wood are used here, too. Maple, beech, and aromatic apple wood give a fine tang to a ham, and corn cobs are considered a choice fuel in some parts of this country. Great commercial packing houses use sticks of wood for fuel though sometimes they burn shavings and even sawdust. In Europe birch and juniper are commonly burned for fuel.

The methods used to cure hams in big packing houses are essentially the same as in the country smokehouse, though the equipment is more elaborate so that large quantities of meat may be handled at one time. These smokehouses vary considerably in height. Some are only a story or two, while others are often very high, having as many as four or five stories to them. In a smaller smokehouse the top section is filled up and the meat allowed to dry before more hams are hung in the section just below. In this way there is no possi-

bility of moisture condensing on the meat and dripping down on lower hams. In higher buildings the smoking process is operated by a conveyor system which moves the meat slowly from the bottom to the top, assuring even drying and uniform smoking as it moves. Today smoking is seldom done as strongly as in the past. Rapid methods of transportation and good refrigeration, which help to keep fresh meats plentiful in our markets, have eliminated heavy smoking as a means of preservation.

The preserving action in this method comes from a combination of dehydration and the effect of a number of chemical compounds, present in smoke, which gather on the outside of the meat and are diffused into the fiber of the food. Smoking prevents the development of microorganisms and repels animal and insect pests. Enzyme action also is stopped by smoking in some cases. In order to be this effective, however, the smoking process must be very thorough, which gives meat a strong, full-bodied, heavy flavor. Done this way, smoking could be used on many different kinds of foods, but the flavor combinations would not be pleasing. So wood smoke generally is applied only to meat and fish. Since other methods of preservation are easily available,



Armour & Co.

HAMS BEING PLACED IN COLD STORAGE AFTER SMOKING

wood smoke is now valued more highly as a flavoring than a preservative. In this case the salting and smoking are done just lightly enough to give the food a delicate, savory flavor. With this milder type of curing now in practice, smoking alone is not enough preservative to prevent spoilage, so that smoked meats must be put in cold storage if they are to keep for any length of time.

Sugar . . . Grass, to the city dweller, is just the covering on his lawn that must be cut each week during summer. The farmer thinks of grasses as the herbage in his meadows that provides pasturage for cattle. But to the botanist grass is a broader term than this. The grasses are a great family of plants spreading over almost all the earth, from the tropics to the far north, from sea level to the snow line of the mountains. Some of these grasses are very tiny, never exceeding an inch or so. Others grow very tall, as much as one hundred and seventy feet sometimes. All the grains we know belong to this great family—wheat and corn, oats, barley, rye, and rice. The plants that grow in lawns and meadows are grasses, too—timothy and red top, blue grass, orchard grass, fescue and clover.

Then there is another branch of this big family you seldom recognize as grasses, called the bamboos. These plants have strong woody stems that attain tremendous heights, but when you examine them you find they have essentially the same structure as the tiny blades of grass growing in your garden. First you will notice the large joints in the bamboo stems. These joints are known as nodes, and the sections between the nodes are called internodes. The stem of an internode is hollow, while a node has a solid tissue growing across it which gives the stem its strength. Bamboo plants are as important to the Chinese as the buffalo was to the Indian or the date palm to the Arab. The first tender shoots to push their way out of the ground are snipped off and cooked for a vegetable. Despite repeated cuttings bamboo shoots keep right on growing, and so they can be used as food throughout the year. Bamboo seeds are also cooked with honey for a sweetmeat or dessert. Besides its enormous value to the Chinese as a foodstuff, the stem of the mature plant may be used for all manner of

Phipps Conservatory, Pittsburgh, Pa.

BAMBOO PLANT

purposes around the home or farm or factory. Cooking utensils, fishing equipment, bows and arrows, articles of furniture, umbrellas, parasols, and baskets are all made from bamboo. Large stems are sometimes cut in sections between the internodes and used for water buckets. Many houses are built entirely of bamboo, too, the round stems forming posts and columns, split stems making floors and rafters, and thinner pieces being woven into lattices for sides. In fact, the bamboo has so many uses we would not have space to list them here.

California and Hawaiian Sugar Refining Corporation, Ltd.

SUGAR CANE

But there is another kind of grass of even more importance to us than all of these — the sugar cane, from which some of our finest granulated sugar is made. Of course sugar is manufactured from other substances nowadays, but until fairly recent times cane was the only source man knew of for white sugar.

In the first years of the Christian era writers mentioned the sweet flavor of what was then called the "Indian reed." It is generally believed that India was the original home of the sugar cane. From India its cultivation spread to China, and from there to Persia and Arabia, where the first methods of refining were developed. After this, in many writings, we find frequent mention of a solid, salt-like product obtained from cane, used generally as a medicine. For many centuries to come sugar was too costly for common use and was limited entirely to medical purposes.

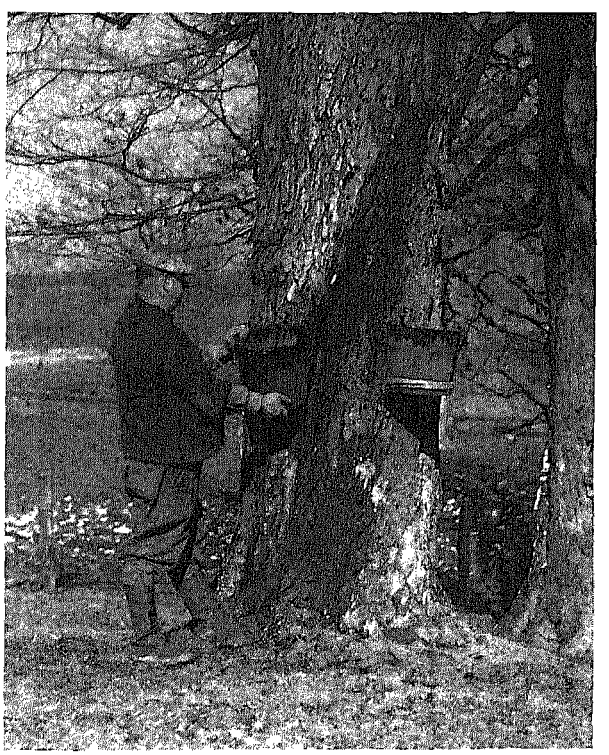
A year to two after Columbus discovered the West Indies, sugar cane was introduced to San Domingo, where the climate proved so favorable for its cultivation that great plantations soon were developed. From this beginning the industry expanded so rapidly in the New World that the duty on sugar from the Indies alone added enormous riches to the coffers of the Spanish crown. During all this time, however, most people still regarded sugar

as a great luxury or medicine, and it was not until tea and coffee drinking became popular in the eighteenth century that the real demand for sugar as a foodstuff arose. Soon after this the production of sugar began to increase in proportion to the demand, until sugar finally became the common commodity it is in our markets today.

In the early colonial days all sugar was imported to this country and was a luxury available to very few. Along the seaboard prosperous housewives generally managed to have a store of loaf sugar to serve when company came to tea. This was a real loaf, too, for it came compressed in loaves or cones often weighing ten pounds or so. Cutting this sugar into well-shaped lumps, with a special kind of shears, was considered such an important task that the mistress or the daughters of the household generally reserved it for themselves in order not to waste a particle of sweet. With thrifty management one of these cones could be made to last a year. And still its use was not exhausted, for each cone was done up in a piece of beautiful blue paper, which, when it was soaked in water, made enough deep indigo colored dye to tint a small amount of wool for weaving.

In pioneer communities, cut off from the seacoast and its imported luxuries, the farm folk fended for themselves, gathering sweets and sugars from the forest. The early settlers soon learned to watch wild bees in flight and follow them until they found hollow tree trunks stored with honey. For other sweets the white men learned from the Indian to make a delicate brown sugar from the sap of the hard maple tree. Making this maple sugar was one of the pleasantest tasks about a farm in pioneer days. Late in a mild winter, or early in the spring, when the sap began to flow in the tree trunks, the men-folk of the family set out for the sugar camp. At first the early settlers gathered sap the easiest way by "boxing" their maple trees. According to this method a deep slash was made across the tree with a sharp knife, then the blade cut in and down so that a large piece of wood was hacked out of the trunk. "Boxing" was quick and simple, but it killed so many trees that thrifty farmers soon gave it up for more painstaking methods. A better plan was to cut a notch in the tree about four feet up on the trunk, then fit a wooden spout into this notch to guide the dripping sap to a long log trough on the ground.

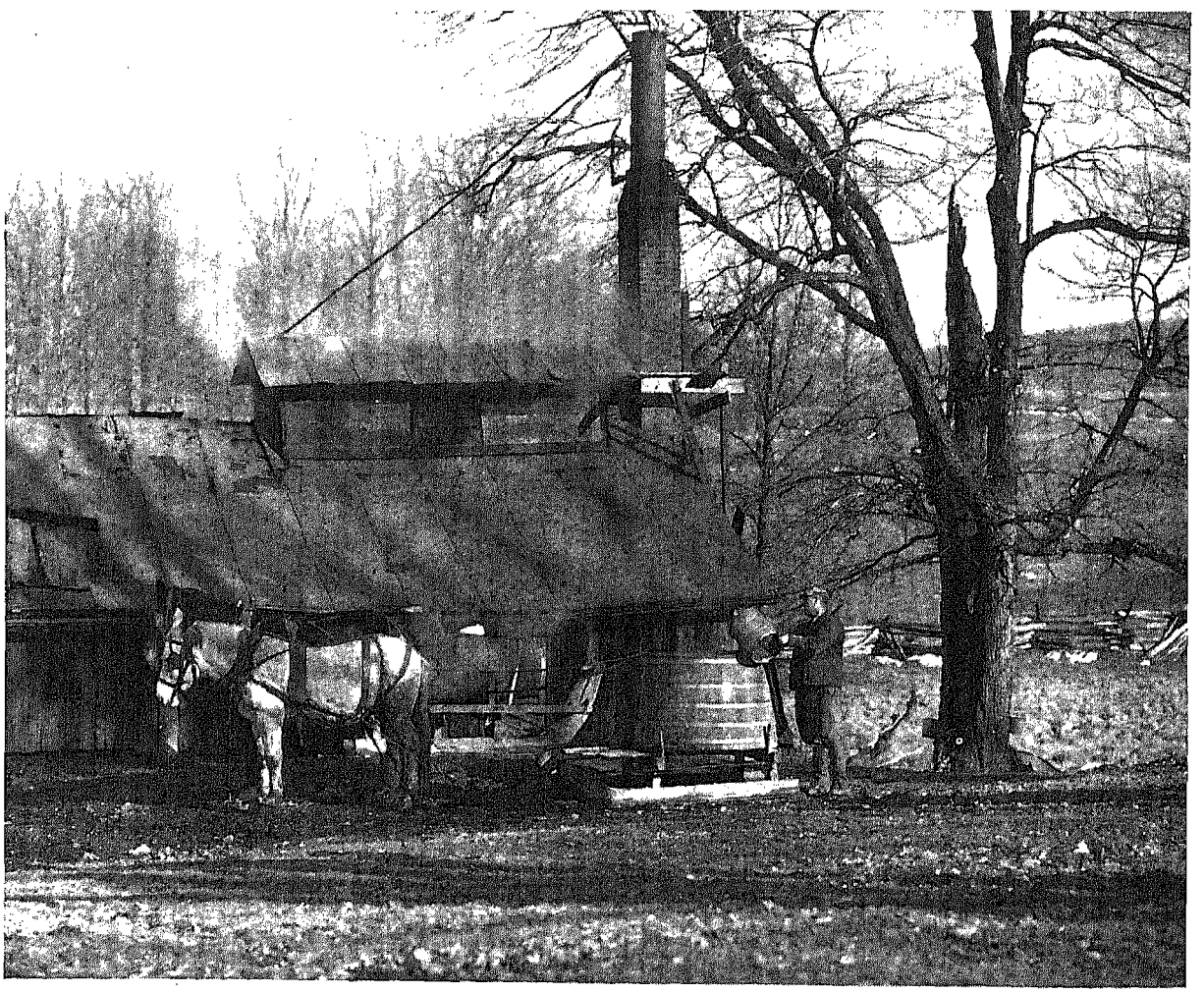
Later, farmers improved these methods further by drilling a hole in each tree that was to be tapped and fitting a hollow wooden stem called a spile into every hole. Wooden buckets known as keelers were then suspended from the spiles so sap would drip down into them. When enough sap had collected in the troughs or keelers it was gathered up in buckets hung on a sap-yolk and carried into camp. In the meantime, back at camp a space



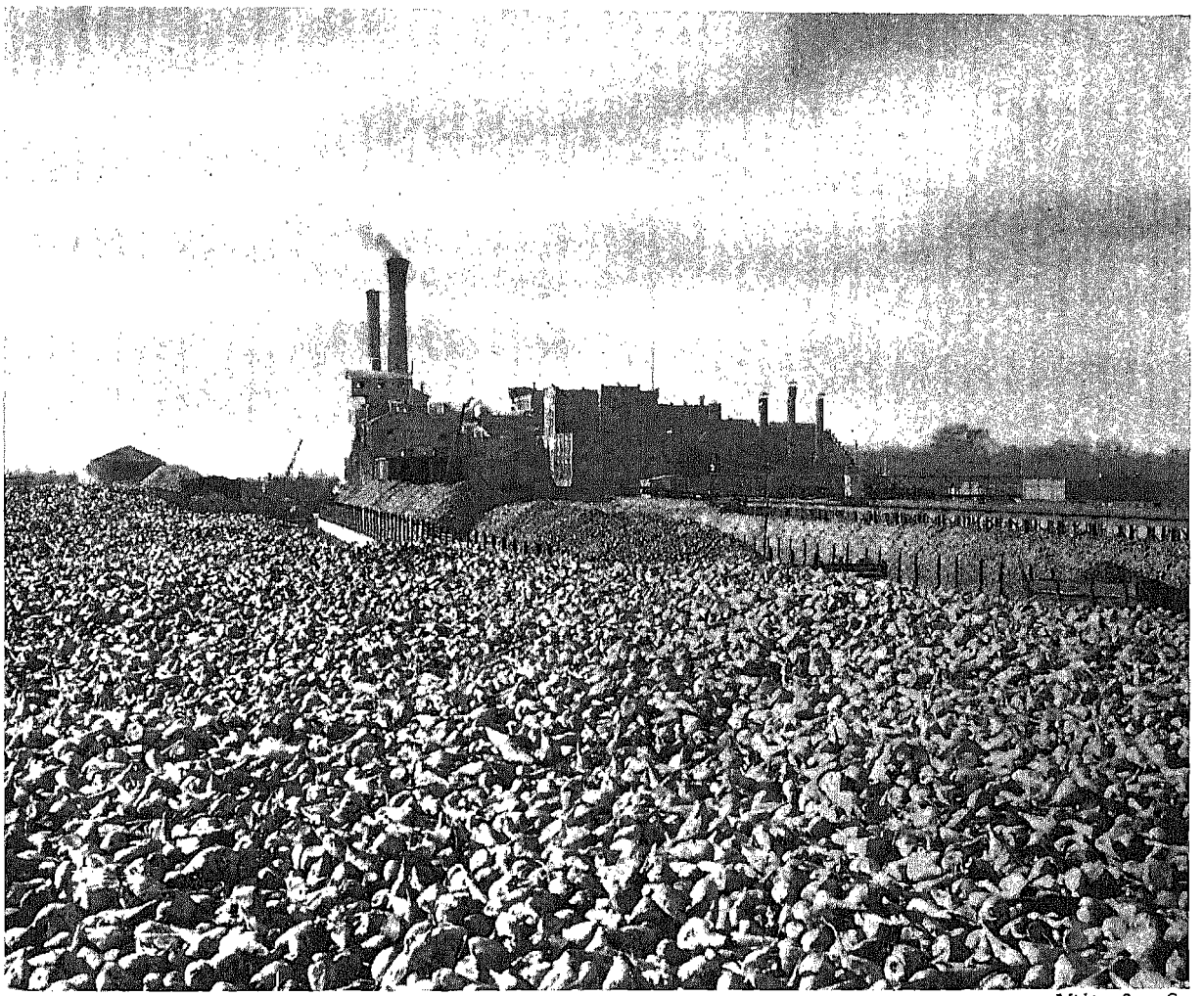
TAPPING MAPLE TREES

was cleared of snow and two forked sticks driven in the ground. If there were two young trees handy that could be used instead, their branches were stripped down to forks and a stout green pole was laid across them. Then a fire was built between the trees, the sap was emptied into big iron kettles hanging from the cross pole, and everything was ready to start the sugaring-off. Over a brisk fire the sap cooked down slowly until all the liquid had evaporated and nothing was left but sweet sugar crystals in the bottom of the kettle. At one time maple sugar was among the cheapest commodities in our markets, while cane sugar was very rare. Today this situation is reversed. Real maple sugar is now a luxury and cane sugar is so common we scarcely stop to think of it at all.

For the past several hundred years scientists have known that beets and other roots contained a store of sugar, but not until the early nineteenth century was a method developed to extract it. When the process was perfected enough to make the manufacturing of beet sugar possible commercially, a factory was established in Silesia. Here the process was so improved that when the Napoleonic Wars made the importation of cane sugar nearly impossible,



OLD SUGAR CAMP



Michigan Sugar Co.

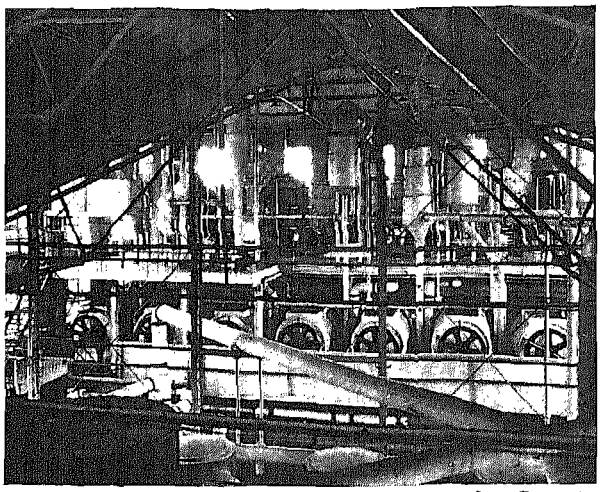
SUGAR BEETS

beet sugar factories sprang up quickly in many parts of France and Germany. Napoleon himself offered prizes for methods of increasing the sugar supply. This, in turn, led to great improvements in the industry. One of the most marked improvements has been the breeding of beets with a higher sugar content. Today sugar beets contain from 16 to 20 per cent sugar, which is about three times the sugar content of beets used in the first factory in Silesia. But even though the sugar content of the beet has been increased so much, a greater amount of sugar still can be obtained from an acre of sugar cane than from an equal area planted with beets. The main advantage of the sugar beet then, is that it is native to a temperate climate like our own, while sugar cane requires a tropical climate and generally must be imported to us.

The first sugar to be manufactured in this country was made in Louisiana in 1794 from cane grown in that state. At one time this industry was so large eleven hundred factories were busy manufacturing sugar in Louisiana alone. Today this number has dwindled to less than one hundred factories, though by using modern methods the total amount of sugar manufactured there far exceeds the amount produced in olden times.

It was not until 1879 that beet sugar was

produced successfully in this country, but the expansion since that time has been so rapid that beet sugar production in the United States today is much greater than cane sugar, over a million tons being manufactured here each



United States Sugar Corporation

SUGAR HOUSE

year. Even with this enormous production we have to import great quantities still from Puerto Rico, Hawaii, Cuba, and the Philippines. Most of the sugar shipped to this country nowadays is sent to great refineries along the seacoast where it is prepared for our consumption. This refining industry was begun early in our history, for records show that even when New York was a Dutch possession called New Amsterdam there were several small but prosperous refineries active there.

This enormous consumption of sugar is due in a large measure to the great American sweet tooth. Probably no other people in the world are so fond of sweets as we are. Even in colonial times, when sugar was such a luxury that only a few could afford to keep a loaf or cone in their homes, bake shop advertisements, menus, and old letters mention a surprising number of sweets of one sort or another. There were dried sweetmeats called suckets, candied orange peel or lemon, caraway comfits, sugared coriander-seeds, candied eringo root, angelica candy, dried ginger, marchpanes, candied nuts, and fruits like figs and oranges and raisins, rock candy, maple sugar, molasses, preserves and jellies, and all manner of cookies, cakes, and crullers. Perhaps it is no wonder that in 1675 a New England poet complained:

> From western isles now fruits and delicacies
> Do rot maids' teeth and spoil their handsome faces.

Statistics show that our national love of sweets and sugar has not decreased one bit since then.

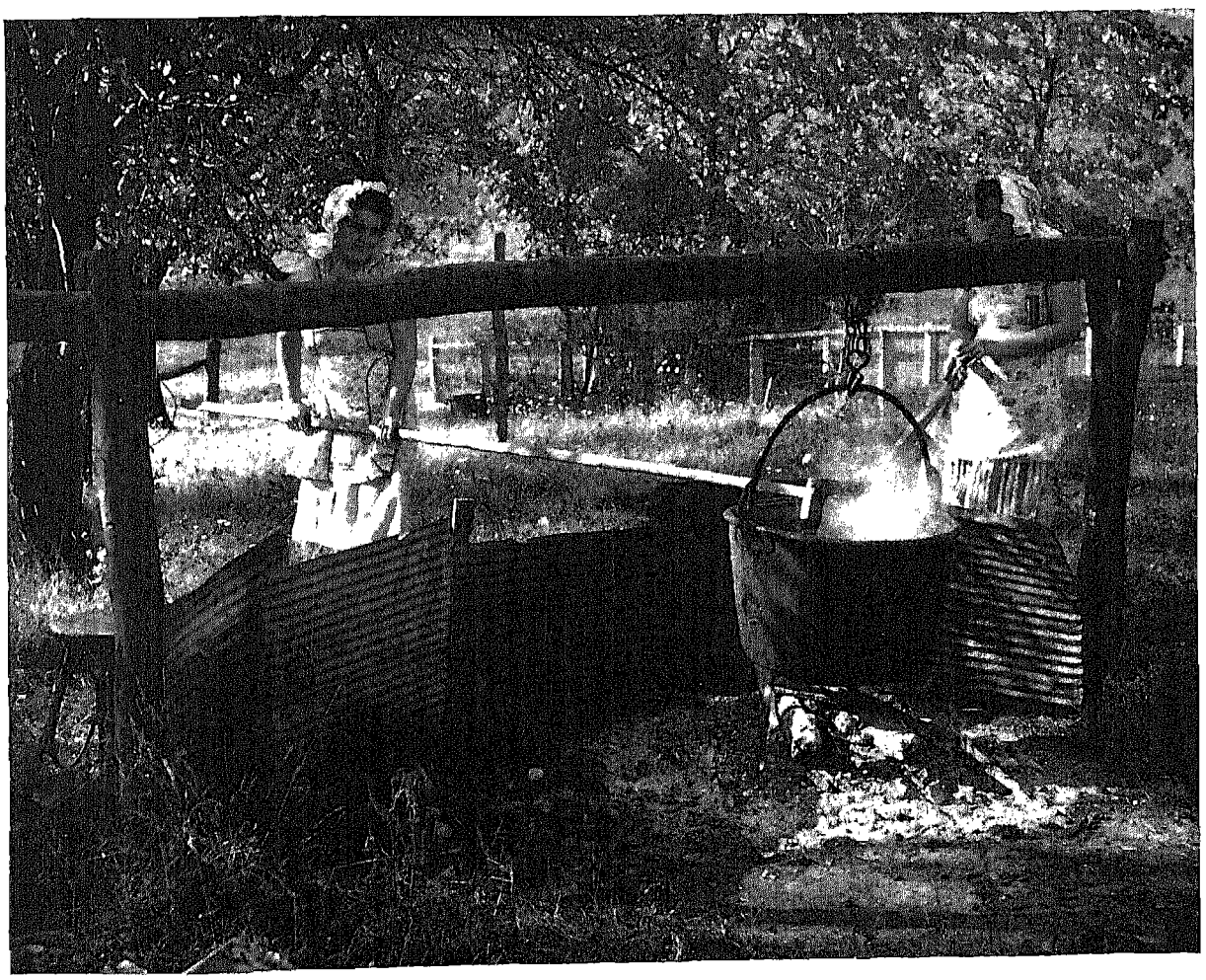
Sugar is an excellent preservative that could be used to keep all kinds of food: meat, fish, vegetables, fruits, any food with enough natural moisture to absorb the sugar. But of all these foods that technically could be kept with sugar, only fruits are really suitable for sugar preservation. You see, sugar, like so many other preservatives in this class, can be used only on foods with which its flavor blends. Fortunately sugar not only combines perfectly with fruit, in many cases even improving the flavor, but it is also an excellent preservative for fruit. When a sugar solution of about 40 to 50 per cent is added to fruit, bacterial action is stopped and the development of molds and yeasts is checked. If the food is cooked also, all molds and yeasts will be completely destroyed and the food will keep indefinitely when packed in perfectly sealed containers.

In order to be effective, however, sugar must be used in lavish quantities, nearly a pound of sugar being needed to keep a pound of fruit. Until fairly recent times sugar was too rare to be used widely in this way. But the high cost, while it did limit the use of sugar as a preservative for many centuries, served a good purpose in the end, for finally it spurred the French government into offering an award of 12,000 francs for a method of preserving food using neither pickling nor sugar. As a result of this offer Nicholas Appert set to work on his experiments and developed the princi-

ples of canning on which a large part of our food preservation is based today.

By grandmother's time sugar had become common enough that she could afford to use it freely. So late in every summer she put up quantities of food for fall and winter. Heavy iron kettles full of sweets simmered on the old wood stove, and the kitchen shelves and table overflowed with bottles, jars, and glasses for preserved fruits. She made jellies, jams and marmalades, packed whole fruits in sweetened syrup, boiled fruits down to spicy butters, and even candied fruits and peelings.

Jellies were made by boiling fruits down, sometimes with water, sometimes without; then straining the juice, adding sugar, and boiling again until the syrup was concentrated enough to jell. Marmalades were made in much the same way as jellies except that small pieces of fruit or peeling were added to the syrup. In making jam the whole fruit was boiled down until it became a thick, sweet, pulpy preserve. Fruit preserves were made by boiling the entire fruit in sugar syrup until it had become saturated with the syrup but not until it shriveled or lost shape. Fruit butters like apple butter, peach, or plum butter were cooked with or without sugar. They had a heavier consistency than jam and were usually highly spiced. Candied fruits were prepared



BOILING APPLE BUTTER

JELLIES AND PRESERVES AT NEW ENGLAND COUNTY FAIR

by boiling fruit in sugar syrup several times, until the fruit absorbed a large amount of syrup, then dried so they could be handled. Sometimes these candied fruits were treated further with sugar syrup until a transparent coating was built up when the fruit was dried. These delicacies were known as glacé fruits.

At first these were mostly homemade products, but the food manufacturers soon learned to adapt their methods of preservation to packing fruits with sugar, and then our markets were well stocked with fine canned fruits put up in sweetened syrup as well as home-style jellies, jams, and marmalades. In America jellies were always the most popular of these preserves. Jams were favored most in England, while the French preferred whole fruits preserved in sugar syrup and candied fruits and peelings. Though great quantities of all these preserves are being put up by commercial canneries today, no doubt the largest amount of sugar preservation is still being done at home.

The ability of fruit juice to jell, which is an important factor in making many of these products, does not depend entirely on cooking down with sugar. There is a substance in fruits called pectin, the presence of which in a large measure determines the stiffening quality of the juice. Apples contain a high percentage of pectin, which may be extracted and added

to other fruit juices to increase their stiffening qualities. Fruits with a high pectin content are often cooked down with fruits of a low pectin content to assure a good jell when the product is done. The amount of sugar used in making different kinds of jellies depends on the amount of pectin present in the fruit. The higher the pectin content the greater the amount of sugar that may be used. This, in turn, assures better keeping qualities in the finished product. The housewife making jellies in her own kitchen knows from experience about how much sugar to add to different fruits, while the manufacturer determines the amount needed by careful tests. In general this rule applies to making most fruit preserves, however — where there is a large amount of pectin present in a fruit, the amount of sugar used generally equals the amount of fruit juice. If the pectin content is low, proportionately less sugar is required to make a jell, two-thirds to one-half cupful being needed for a cup of juice. The use of less sugar in this case necessarily reduces the keeping qualities of the finished product.

The preservation of so many different kinds of fruit with sugar added a welcome variety to the American diet. Before sugar was cheap enough to use this way, fruit was available just a short time during the year. There was no refrigeration or quick transportation in those days; so all fruit was home-grown and the season seldom lasted longer than the summer. When this was done most families went back to their standard heavy diet of cakes and pies and puddings relying on dried products if any fruit was needed.

Even with the rapid transportation and refrigeration we have today, so that fruits may be shipped to us from different sections of the country all year round, there are gaps in the schedule still when some fruits are not available in our markets. When that occurs we always have preserved fruits to fall back upon. But their use is not limited to this, for all of us enjoy the sweet flavor and fine quality of good preserved fruits — peaches, pears, pineapples, plums, cherries, raspberries, etc.—and use them in many of our meals. So the demand for preserved fruits has not diminished, and quantities of fresh fruit are still put up with sugar both in our homes and by the commercial cannery.

Spices . . . In the thirteenth century Venice was the business center of the world. This city was built in a strategic spot midway between the East and West. She was the nearest seaport to the heart of Europe, and all the known routes to the Orient were under her command. Into her port poured the luxuries of the East bound for western towns and castles — gems and silks and deepest velvets, rugs of rare design and beauty, perfumes, incense, fruits, and spices — all the riches people yearned for. The Rialto, where her merchants conducted business, was the clearing house of Europe. There was great opulence and beauty in this medieval town. The streets were threaded with canals spanned by bridges of brick and stone; fabulous Byzantine palaces lined the waterways; and Gothic houses of great delicacy and charm were built along the Grand Canal. There were bazaars of Oriental splendor, and great cathedrals towering to the skies. Venice, in the Middle Ages, was a world power.

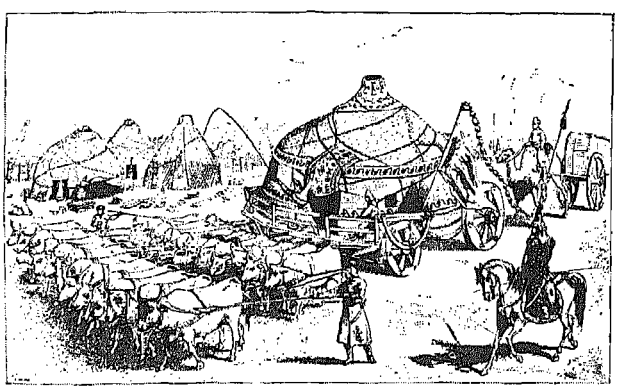
Into this city in the year 1295 came three merchants — a young man, lean and worn with travel, and two shabby older men wrapped in padded rags and tatters. Their faces bore a Tartar stamp; their native speech was rough and broken. On their backs were heavy bundles bound in strips of eastern fabric. Dazed at the strangeness of the streets after all their years of travel, they wandered up and down the town until they found a house that seemed familiar to them. A rap on the gate brought strangers to the door, however, who refused to let them in though they insisted this was

their old home. It was only by threats that they forced their way into the outer courtyard; then distant relatives were called from all about the town to identify them before the travelers were allowed inside the house that had been their family home for many, many years.

These men were Marco Polo, his father Nicolo, and his uncle Maffeo. They had been away for twenty-four long years, and all the town had given them up as lost. For many years the house of Polo had been one of the most daring trading families in all Venice. Long before this time the two older men had gone farther into the Orient than other traders dared to venture. When Marco was seventeen they thought him old enough to bear a man's share in their travels; so they took him into their business, and the three of them set out to trade at the court of the Great Khan in faraway Cathay. For three and a half years these bold men traveled, across lands and seas and deserts unknown to other Europeans, in those days. They crossed Persia and Afghanistan, the plateau of Pamir, the great Gobi Desert, and many other far-off places we do not hear of again until we read modern tales of exploration and adventure.

At the court of Kublai Khan, the Mongol conqueror-emperor, the young Marco Polo became a great favorite. He was discreet and entertaining, so the Khan entrusted him with many missions and vested him with high office. Wherever Marco Polo went he took notes on curious things he came across with which to entertain the Khan. Here in China were many things incredible to Europeans in those times. There were birds and animals unknown to western men. He saw books of paper printed by movable type when Europeans were still illuming manuscripts on vellum. He saw gun powder and paper money, porcelains and bronze castings, prints and paintings of surpassing beauty. There were wonderful buildings and engineering marvels like the Great Wall of China and the Grand Canal from Peking to Canton, which is still the longest waterway of its kind ever to be made by man. In China there was a kind of living unknown to Europeans for many centuries to come.

After dwelling here for seventeen years the Polos wanted to go home. The emperor was getting very old and his courtiers were bickering among themselves. Soon Kublai Khan would die and his vast empire fall apart. There would be no safe place then for these favorites from the western world, for the wealth and



Darlington Library, University of Pittsburgh

TARTAR HUTS AND WAGONS IN TIME OF MARCO POLO

honors showered on the Polos had made them many jealous enemies. The emperor was loath to let them go, but finally he gave permission and an escort for their safe return. For three and a half more years they traveled before they appeared, tired and shabby, on the streets of Venice, begging admission to their home.

The big Italian cities in those days were great rivals for world trade. Their merchant fleets sailed all the seas, and when they met, unpleasant incidents occurred that led to frequent wars. In 1298 Venice and Genoa were once again at war. All the great shipping families supplied galleys and among them the Polos sent out their craft with Marco Polo in command. This time the Venetians were defeated in a fierce battle and Marco Polo was

captured. While he was imprisoned in Genoa, Marco Polo sent home for the notes he had taken to amuse the emperor of China, and it was during these months he spent in jail that he wrote the story of his travels as we have them today.

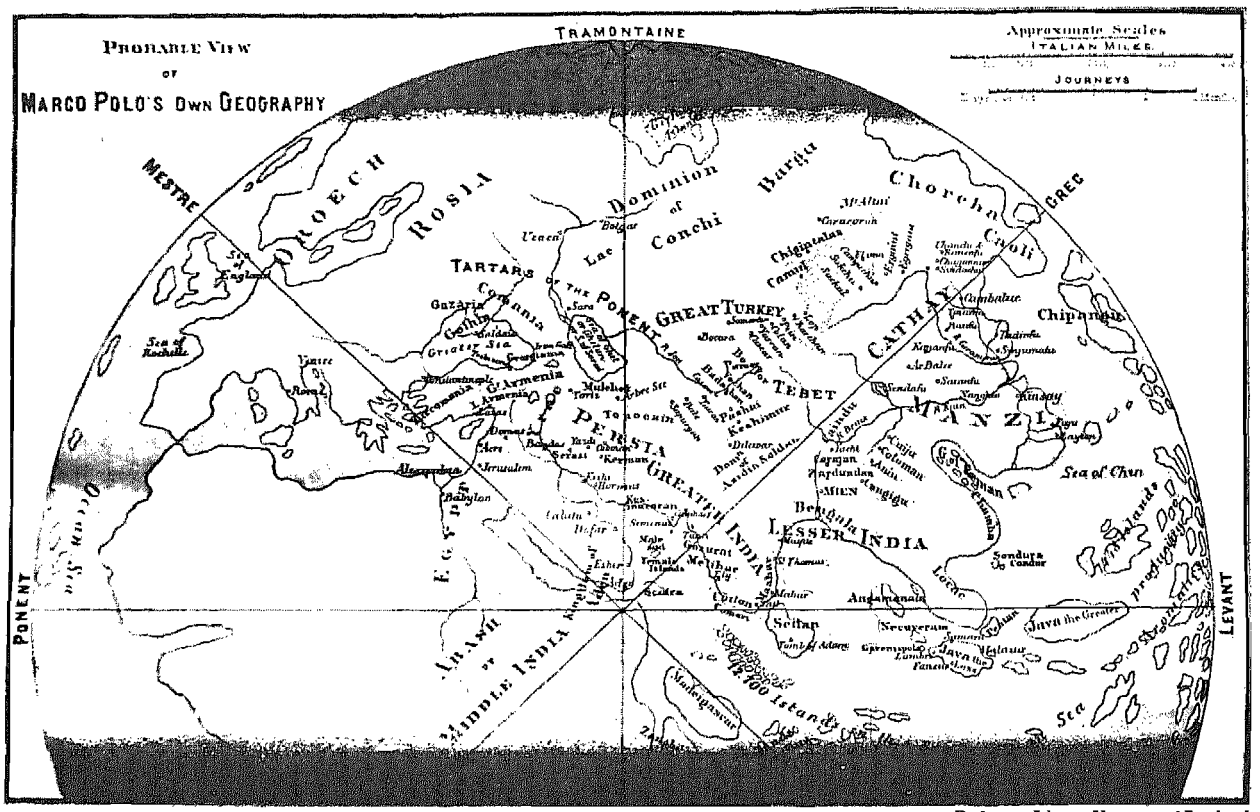
The Italian merchants knew the near East well. Persia, Syria, Constantinople, and all of Asia Minor were familiar trading grounds. But the far East of China, Tibet, the Indies and Afghanistan were unknown to most people in those times. Few navigators dared to venture out beyond the land-locked waters of the Mediterranean. So from the first no one believed Marco Polo's stories. In spite of the fabulous wealth the travelers carried in the bundles on their backs; the gems and precious metals, brocades and silken damasks, the sandalwood, perfumes, and rare incense, the Venetians simply shook their heads and laughed. Because in all his tales he dealt in millions, in gold and distances and peoples, Marco Polo was dubbed Marco of the Millions and his home was called the "Court of the Millions." His tales of towering mountain peaks, vast deserts, sprawling cities, and lavish courts of eastern rulers, even the incredible wealth of the Orient were all branded as enormous lies. When he lay dying his family begged him to recant that he might not leave the world with such sins upon his head. But Marco Polo murmured he had not told one-half of all he'd seen and died without denying any of it.

Marco Polo wrote of great hardships — of unbroken mountain ranges to be crossed; of deserts without a drop of water; of tortuous temperatures, swollen streams and rough seas; of robbers that fell on travelers from caves beside the road, and stripped them, and beat them and left them to die; of the tyranny of petty chiefs, the vengeance of savage kings; of disease and danger greater than men could endure. Italian merchants who traveled over much smaller territory in the near east suffered some of these same hardships. A few managed to return after great delay. Some came home so broken in health they never would recover. Many did not live to come back home again. But to those who were successful the profit in the eastern trade was enormous.

In time a few other merchants reached the far eastern markets; then some began to believe Marco Polo's tales. But the great dangers standing between them and the riches of China and the Indies prevented many from attempting such a trip. Up to this time all travel to the East had been by the overland route, across the Mediterranean to Constantinople, then on by camel caravan, pack horse, and afoot through more treacherous country than most men cared to hazard. The Atlantic rolled away to the West, a vast, uncharted sea of water. A few ships sailed along the sheltered eastern shore, but none except the Norsemen ever ventured far upon it. Legend peopled the Atlantic with terrifying monsters and titanic storms. Sailors called it the Sea of Darkness. No one would set sail upon it, and no one dreamed that new lands lay beyond it. And so for centuries half of the world was unknown to European men.

In the early Middle Ages sailors had no compasses nor astrolabes, no maps nor charts nor calculations. Their ships were mostly galleys manned by oars and one small supplemental sail. Then instruments were developed, and ships were rigged with bigger, better sails, so that by the fourteenth century men were ready to risk the unknown seas. About this time some of the more daring traders began to seek an all-water route to the Orient that would eliminate the danger of overland travel.

A few navigators advanced the theory that by sailing very far west they might in time come to the markets of the East. No one counted on the two continents of the Americas lying in the path. The boldest of them all said the earth



THE KNOWN WORLD IN TIME OF MARCO POLO

was round, and that any point in the world could be reached by sailing either east or west. When Columbus discovered America by accident, while trying to prove his theory, most people thought the quest was ended, that these new lands were the Indies Marco told of, and the hope of finding great wealth here in gems and precious metals lasted many years.

After Columbus crossed the Sea of Darkness men no longer feared to venture in different directions on the seas, and every powerful nation began to seek a trade route of her own to the Orient. In the course of these explorations many new lands were opened to European people. Vasco da Gama sailed around the Cape of Good Hope and up the eastern coast of Africa to claim India for the crown of Portugal. On a later expedition to the Indies he was blown off his course and landed on the coast of South America, establishing the rights of Portugal to Brazil. The Cabots, sailing for the English king, crossed the Atlantic and landed on the coast of Newfoundland. Magellan steered his ship down around the tip of South America, through the straits bearing his name, and on across the great Pacific. Jacques Cartier explored the Gulf of St. Lawrence and claimed a large part of the upper half of North America for France.

Soon the Portuguese, the Spanish, the Dutch and French and English all had powerful trading companies that sought the exclusive right to deal with these new lands. But still the search for new paths to the Orient went on. For even in this country the legend persisted until recent explorations proved it false, of a great Northwest Passage, a waterway extending across the upper end of North America from the east coast to the west, through which ships could sail straight to China and the Indies.

Why was this trade so valuable? What did the European nations want that they would send fleet after fleet in exploration and run the risk of war to find these far-off lands? Marco Polo told of fine woolen fabrics, cottons and silks and damasks woven with threads of gold, precious stones, rare fruits, curious plants and incense strange and wonderful to the western world. But through all his notes there ran one continuous thread of fact of more importance than all of these. Time and again he mentioned the abundance and uses for spice. Spices were reckoned second only to gold as a business risk worth chancing life and fortune for in those days.

Lavish quantities of spice were used in almost every kind of food. Each family of means had a spicery, a cupboard kept under lock and key, supervised by a trusted servant who doled out proper portions to the cook. Table knives and spoons were not as common as they are today, and forks were unknown then; so most food was cut in small pieces, cooked a long time, and smothered in a highly seasoned sauce to give it flavor. Meat was served in stews and pasties, soup was very common, and sausages and puddings were staple items in the diet. And all of these, soups and meat, and even bread, and cakes, and wine were seasoned heavily with spice. An old recipe for sausage suggests:

> Take pork and pound it in a mortar with eggs; add sugar, salt, raisins, currants, minced dates, powdered pepper and cloves; put it in a bladder and boil it; then cut in slices. This was served with a sauce made of raisins, red wine, almond-milk coloured with saffron, pepper, cloves, cinnamon and ginger.

And here is a soup suggested for a fast day meal:

> Trout, herring, eels salted twenty-four hours, and salt whiting soaked twelve hours, almonds, saffron, and cinnamon powder.

In a book written by a sixteenth century Spanish physician, *Joyfull Newes out of the Newe Founde Worlde*, Nicholas Monardes says of ginger:

> It giveth savour, and sweete smell, and good taste, unto drest meates, where it is put.

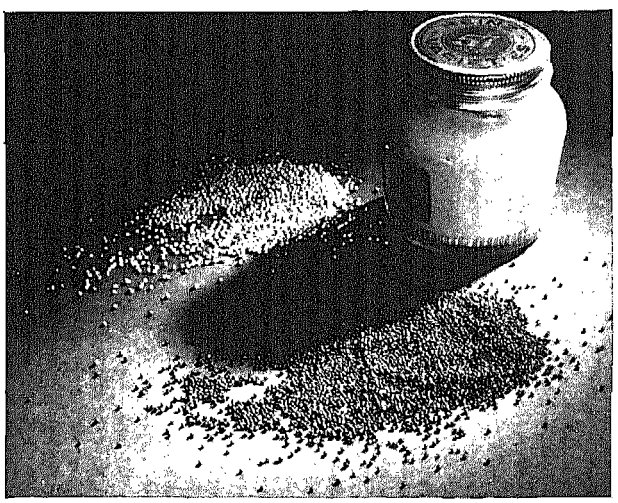
Many other spices are described in this book and praised for the flavors they give food. It is hard for us to understand this medieval fondness for strong food, and it is doubtful if we could eat many dishes spiced so lavishly today.

Spices were also used as medicines in those days. Dr. Monardes wrote his *Joyfull Newes* almost entirely from a medical point of view, and he ascribed such remarkable healing powers to spices it is surprising there was any disease left in Europe if the cures were as effective as he claimed. Cinnamon was recommended as a cordial and a stimulant. Ginger was valued highly as a cure for colic and dyspepsia. To relieve toothache and swelling in gout, ginger oil was warmly recommended. Ginger plaster was applied externally to ease the pain of headache or a throbbing tooth. Nutmeg was said to be good for dyspepsia, and cloves were commended also for dyspepsia, gastric irritation and for toothache. Allspice relieved neuralgia and rheumatism, and pepper was advised for indigestion, mistiness of the eyes, cholera and even as a stimulant in cases of snake-bite. Today, of course, we know spices do not have all these healing properties, though a few of them are still listed in standard pharmacopoeia as relieving agents in certain illnesses.

Spices also served to help keep the strong, rich foods people were fond of in those days, though there is some question as to how widely they were used as preservatives even then. The peasant seldom had much extra food for preservation. He grubbed a meager living from the soil, and ate black bread and poor man's soup and crumbs tossed from the great lord's table. The nobles lived extravagantly on wild game from their forests, on birds struck down

by their hawks and falcons, on fish from their streams, cheese from their dairies, fruits, and vegetables, and greens grown in the castle gardens. Most game for the noble household was killed and cooked from day to day, and there was little thought of preserving food except for times of siege. There is no doubt that some foods, fruits and vegetables and meats were put up in spice, but seldom in great quantities.

Probably the most frequent use of spice in those days was not to prevent spoilage from starting, but to mask the taint of spoilage already present with the sweet perfume of spice. Spoiled food was a commonplace in the Middle Ages. None of the facilities we have



YELLOW AND BROWN MUSTARD SEEDS

for handling food existed then. When fresh foods were brought to the town or castle they had to be used at once or they would decay. Meats especially began to lose their freshness in a few hours. But meats were too expensive to be discarded because a little putrefaction had set in, so the rank taste was usually covered up with spice. It was not unusual for the meat to be more than just a little spoiled either. Pepys mentions in his diary that one night a roast was served smelling so badly it had to be taken off the table before it could be cut, not an uncommon occurrence even in his time.

Perhaps one reason why they were not used more frequently as preservatives is that spices alone really do not prevent spoilage. It is true that some spices will keep foods when they are used in concentrated quantities. Cloves, for instance, have strong enough essential oils to preserve foods successfully by themselves. But most other spices require some additional preserving process in order to be effective. In time, as better methods were developed, spices came to be used less as preservatives and more as seasonings until now we regard them simply as a source of piquancy and flavor for our foods. While spices still are added to some preserved foods, such as fruits and relishes and ketchup, their preserving function is so slight that in most cases the spice could be omitted without affecting the keeping qualities at all.

Spices come from many different kinds of plants. Some are made from roots, some from leaves and stems, and some from buds and fruits and bark. Most spice plants require a mild climate in which to grow, their native habitats ranging from warm-temperate to tropic zones. The East and West Indies are the largest spice producing regions in the world, and with the exception of vanilla and cayenne pepper, all the important spices are native to these lands.

Ginger is made from a rhizome, an underground, root-like stem of a perennial plant cultivated throughout the Indies. During the course of its growing season this plant attains a height of two to three feet. After flowering the leafy stems turn yellow and begin to shrivel. Then the rhizomes are dug up, shaken to remove the dirt, and stripped of the little rootlets growing on the stem. After being trimmed the rhizomes are scalded in hot water, laid out in the sun to dry, and then packed in great bundles of a hundred pounds or more for market.

Jamaica ginger, which is considered by many people to be the finest quality, is generally peeled, or what is called by the trade uncoated, before it is shipped to market. The outer skin of the rhizome is stripped off with a sharp knife, then the rhizome is washed in

GINGER

water, and soaked over night in water to which lime juice is sometimes added as a bleaching agent. Palm or banana leaves are spread on the ground and the ginger is laid on them to dry in the sun. Large-sized, firm, light-colored rhizomes are considered the choicest ginger on the market.

Ginger has been known since very ancient times. The early Greeks and Romans evidently secured ginger from Arab traders, for there are frequent references to ginger in old import lists from the Red Sea into Alexandria where the Roman customs agent collected duty on it. Long before the Norman Conquest ginger was well-known in England and was recommended as a cure for many illnesses.

For thousands of years cinnamon has been used by man. Moses was commanded to use quantities of cinnamon in making a holy oil for the Tabernacle. Records show that the Egyptians imported this spice as early as 1600 B. C., and cinnamon was used frequently by the early Greeks as a votive offering to their gods. After the Indies were opened to European trade the history of cinnamon followed the careers of the great trading companies. The Portuguese acquired a monopoly on cinnamon when Vasco da Gama claimed Ceylon for their crown. Then the Dutch seized Ceylon and its spice trade in 1656, and tried to keep a rigid monopoly of this spice to maintain a high price on the market. At one time, when there was a surplus on the market, the Dutch ordered all cinnamon stored in warehouses in Holland burned in order that the price might not be depreciated by the abundance of the supply. In 1796 the English wrested Ceylon from the Dutch and acquired a monopoly that lasted until 1833, when the trade was turned over to private merchants.

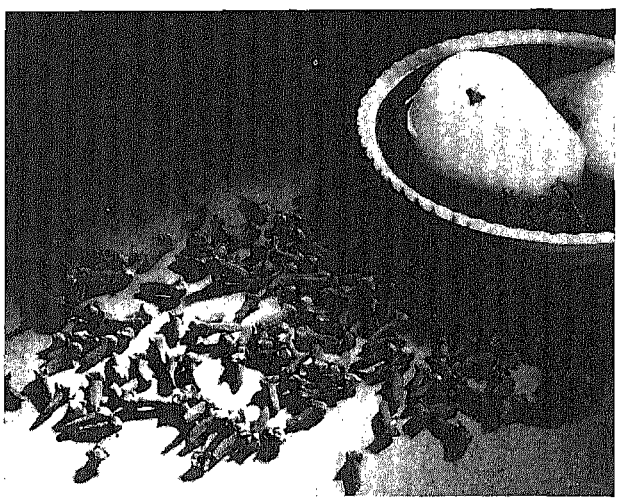
Cinnamon comes from the bark of an evergreen tree native to Ceylon. This tree grows about twenty to thirty feet high, has a sturdy trunk and many bushy branches. Spice is made from this tree by cutting and peeling off the bark. When the sap begins to flow the shoots are cropped and stripped of leaves and branches. These shoots are then packed in bundles and taken to a shed where the bark is

CINNAMON

deftly slit with a sharp knife and peeled off in two lengthwise strips. Then the slips, as these strips of bark are called, are laid together and covered for the night. Next day the outer skin is scraped off each slip; the pieces are graded and cut and stacked together in long pipes. To cure them further, the pipes are spread out in the sun under mats, to keep the direct rays from warping them, and left to dry. Quality cinnamon is thin and light in color.

Look closely at a well-shaped clove and you will see it is a dried, unopened flower bud. These buds come from beautiful evergreen trees that grow thirty to forty feet high, bearing large oval green leaves and clusters of brilliant red flowers. Clove trees begin to blossom when they are from five to seven years old, and they continue bearing flowers for a hundred years or more. When they first appear the buds are green, then they take on a yellow tinge and finally they become a brilliant crimson and are ready to be harvested. Sometimes curved sticks are used to bend the branches down and the buds are then gathered by hand. Sometimes the buds are shaken loose by knocking the branches with bamboo sticks. Ladders are often laid against the trunks, so that the pickers can climb up and reach the buds. In some islands the native boys and girls scramble up the tall trunks and shake the branches until the ground is covered with a carpet of pink and white and crimson petals, and the air is spiced with a fragrance that wafts far out to sea. Then the buds are picked off the stalks and laid on mats to dry in the sun for six or seven days, being taken in only at night to prevent the dew from dampening them. At the end of this drying period the cloves have lost 50 to 60 per cent of their weight and have become a very dark brown color. They are then gathered and packed in gunny sacks ready to be shipped to market.

More than any other spice, cloves were coveted throughout the Middle Ages. When the Portuguese secured control of the clove market all the other nations tried to wrest it from them. In 1605 the Dutch seized the Spice Islands and attempted to regulate the price by destroying all clove trees except those growing on the Amboyna Islands. It took many years to break this monopoly, and the destruction was

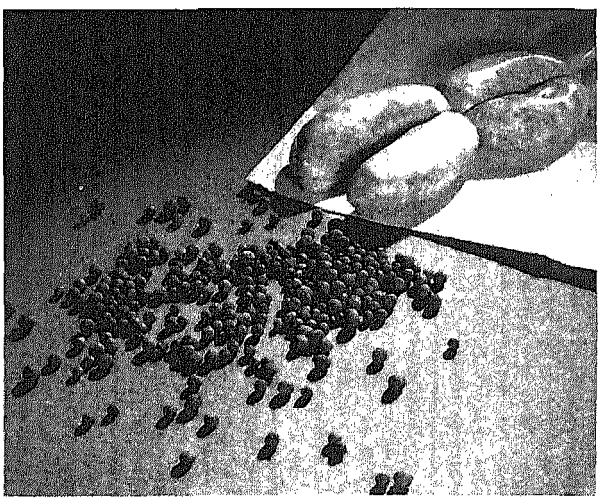


AMBOYNA CLOVES

so thorough that only with a great deal of difficulty were clove trees replanted and grown successfully again on the islands where they had once been native.

Allspice is a member of the pepper family but, unlike other peppers, it has a sweet and piquant fragrance like a blend of cinnamon and cloves and nutmeg. This spice is the sun-dried fruit of a tree native to the West Indies, Mexico, and Jamaica. The allspice tree grows about twenty to thirty feet tall with a slender trunk and smooth bark. The leaves are a shiny green, and the flowers are tiny and fragrant and white. While the berry clusters are still green, the agile natives climb the tree trunks, breaking off the best boughs and dropping them on the ground. Here the women and children busy themselves picking berries from the branches and placing them in baskets. To cure them for the market the berries are

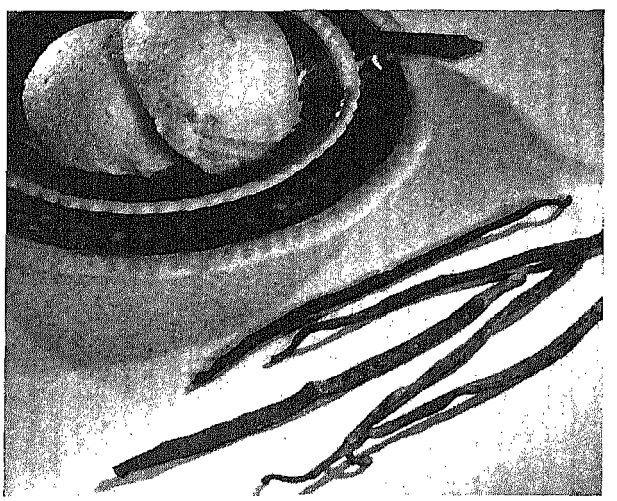
laid out in the sun to dry. Here they stay for three to twelve days until the fruit is dry enough to rattle. Then the berries are cleaned in a machine and packed away in bags.



ALLSPICE

Vanilla is one of the few spices not of Oriental origin. The vanilla bean is native to Mexico and South America and was being used with great skill in the manufacturing of chocolate by the Aztecs centuries before the armies of Cortes invaded Mexico City and conquered Montezuma. Vanilla is made from the fermented and dried pods of a clinging vine of the orchid family. This plant has a long fleshy stem with aerial rootlets by means of which it attaches itself to trees. These roots also penetrate the soil from which the plant receives some nourishment, too. The vanilla plant has fleshy leaves, light green flowers, and fruit pods six to ten inches long. At first these pods are a deep green, but as they ripen they take on a yellowish tinge and are ready to be cut off.

After the pods are gathered, the drying and curing process is begun. This is the most exacting part of vanilla manufacture and there are many different ways of doing it, though all of them are based on the sweating principle. Some planters use hot water, some stove heat, and some sun drying to cure the vanilla pods. The most common method is to heap the pods in a building where they will be protected from the sun and rain, and allow them to stay there several days until they start shrinking. Then the pods are spread on a woolen blanket in the sun to absorb heat for a few hours, after which they are covered with a blanket and allowed to remain sheltered, but in the sun, for the rest of the day. In the evening the pods are placed in tightly closed boxes where they will sweat the whole night through. This process is repeated until the pods have become a very deep chocolate color. If the weather is damp, an oven process is substituted for the sun. Next the pods are arranged on mats in the sun every day for about two months until they are dry and are ready to be tied in bundles for shipment.



VANILLA BEANS

Centuries ago pepper was a staple article of commerce between India and Europe. Many ancient people knew the use of pepper. The early Greeks and Romans valued it highly and often levied tributes and ransoms in terms of pepper. When Alaric sacked the city of Rome and demanded ransom in 408 A. D., 3000 pounds of pepper was exacted as part

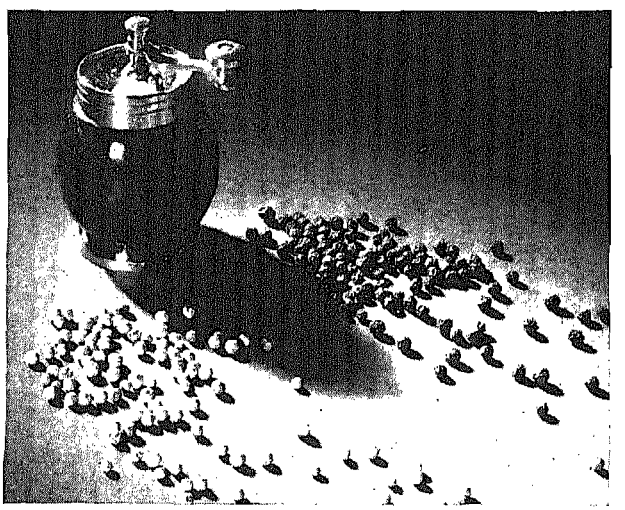
payment from the town. Throughout the Middle Ages pepper was a treasured commodity to European merchants. Genoa and Venice and many other wealthy cities owed a good part of their prosperity to the pepper trade. In medieval England, rents were sometimes paid in pepper, and in the twelfth century a pepperers guild was formed by the traders to protect their rights. After the Portuguese discovered their passage to the Indies around the

TALAY AND MOMBASSA PEPPERS

tip of Africa, pepper became a monopoly of the crown, and continued to be under Portuguese control until the seventeenth century. When the Dutch wrested the Malay Islands from the Portuguese they attempted to limit pepper production as they had with other spices, but pepper was grown too widely for this monopoly to succeed. Various kinds of pepper are made from the dried fruits of different species of pepper plants.

Black pepper is made from the unripe fruits of a perennial clinging shrub. This shrub climbs on tree trunks and stakes by means of roots like ivy, so it is generally known as the pepper vine. To make black pepper, the berries are gathered before they are ripe and spread on mats to dry in the sun. Some planters plunge the berries into boiling water first before spreading them out to dry as this makes the skin tougher and gives the pepper a blacker color. Others prefer to dry peppercorns over a slow fire in a smokehouse. In both sun drying and drying over a fire, the berries must be turned often to dry evenly and prevent mildew. As the pepper dries the berries darken until they are black; then they are rubbed to remove the peppercorns from the stalks on which they grew.

White pepper is made from these same berries, but the fruit is allowed to stay on the plants until it is well ripened. When they are picked, the little red berries are put in bags and soaked in water for a week or so to loosen the skins. Then the peppercorns are put in tubs of water and trampled on until the skins



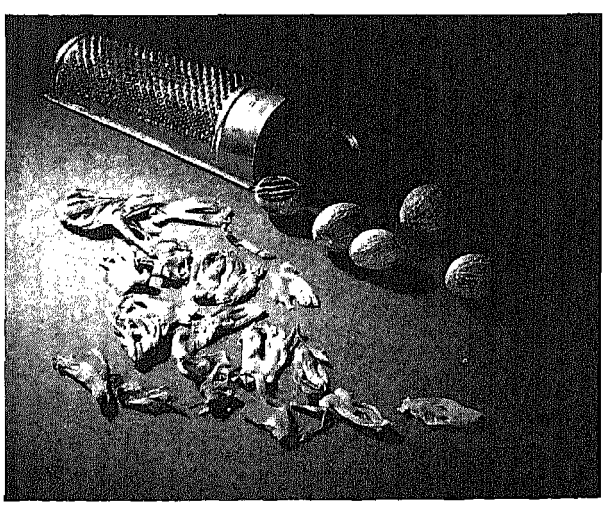
WHITE PEPPER AND BLACK PEPPER

and stalks have been removed. After this the peppercorns are spread on mats and dried in the sun until they are ready for market. White pepper made this way is less strong and pungent than black pepper, but it has a finer flavor.

Cayenne pepper is a kind of chili powder made from a small shrub native to Central and South America, but grown now in warm climates all over the world. This bush grows about two to three feet high and bears glisten-

ing red-orange pods about half an inch long. When the fruits are ripe they are spread in the sun to dry. In the West Indies cayenne pepper is made by drying the fruits in the sun; then the pods are arranged in layers in a baking pot with flour spread between the layers and put in a slow oven. When the pods have dried thoroughly the flour is shaken off and the pods are beaten or ground finely. Then wheat flour and leaven are added and the mixture is made into little cakes that are baked until they are hard and dry. Again the cakes are beaten; then the powder is packed in tightly sealed jars and shipped to market.

Nutmeg is the whole kernel of the seed of a tall evergreen tree native to the Banda Islands. About eight years after the seeds have been sown these trees begin to bear fruit, and from then on they continue to yield for sixty years or longer. The ripe fruit, which is a very delicate orange color, is pear shaped, and about two inches long with a deep groove running down one side. When the fruit is fully ripened, it splits open along this groove, exposing a crimson coating over a single seed. This lacy red covering, which is stripped off carefully and dried, makes the spice known commercially as mace.



NUTMEGS AND MACE

The seed itself consists of a hard, polished, brown shell enclosing a wrinkled woody kernel nearly one inch long which, when dried, becomes the nutmeg. To prepare these nutmegs for the market the whole seeds are spread out in the sun to dry or they are dried over a slow charcoal fire for about two months, the seeds being turned every few days so they will dry evenly. When they are done the shells are broken by tapping with a truncheon or a flat board and the nutmegs are picked out and sorted. Sometimes the nutmegs are then rubbed over with dry lime or soaked in lime-water to protect them from beetles and to keep them from sprouting, though exposure to the sun for a week or so is really all that is needed to prevent germination.

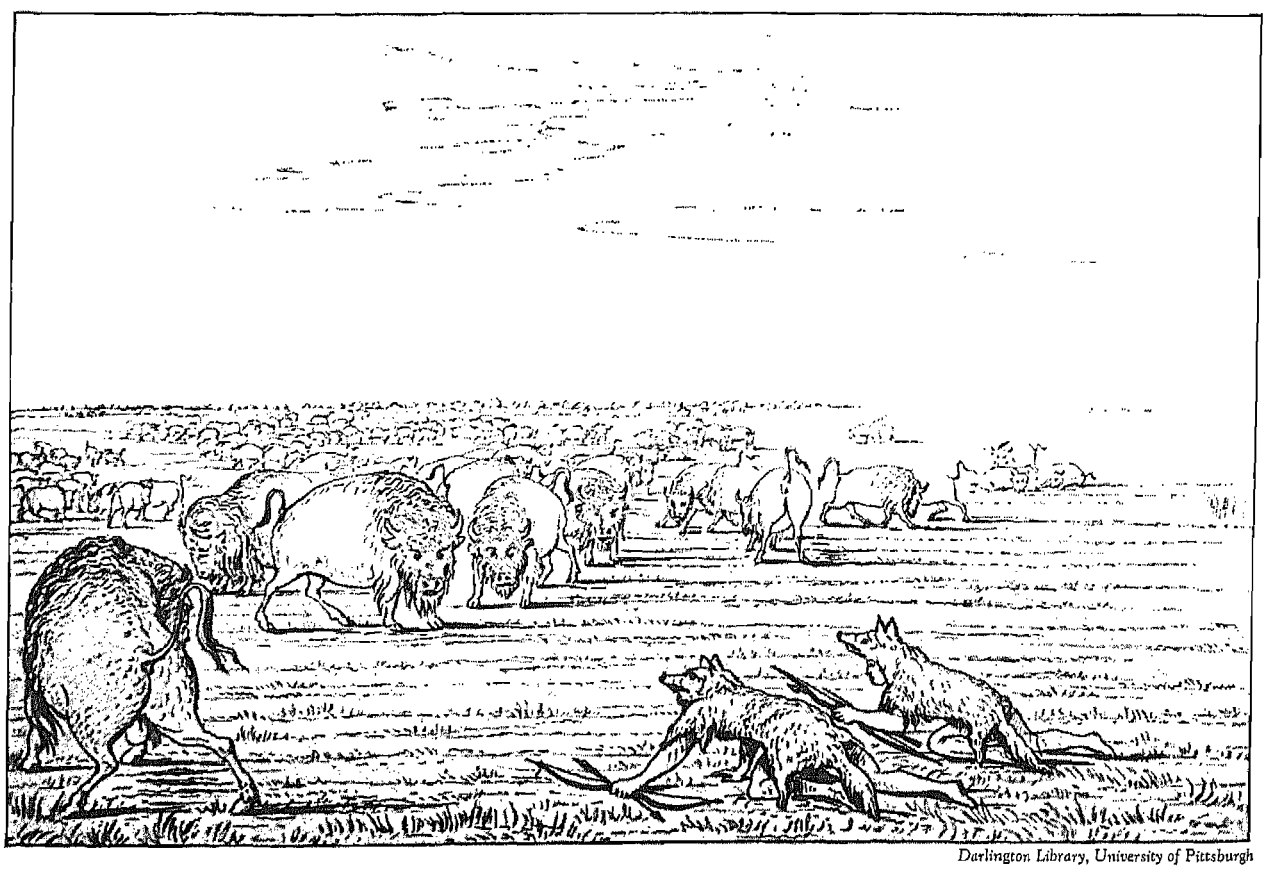
There is no record of any spice resembling nutmeg in ancient Hebrew, Greek, or Roman writings. The earliest mention of nutmeg in Europe is in a twelfth century poem describing how the streets of Rome were perfumed with nutmegs and sweet spice for the coronation of the Emperor Henry VI. Like so many other spices nutmegs and mace were controlled first by the Portuguese and then by the Dutch, who attempted to curtail the cultivation by permitting nutmeg trees to grow only on the Islands of Banda and Amboyna. Fruit pigeons interfered with this plan, however, by swallowing the seeds and carrying them to other islands. At one time during this period the warehouses in Holland held sixteen years' supply of nutmegs which the Dutch were forced to burn in order to keep the market price from falling. When the English began nutmeg cultivation in their colonies the monopoly was completely broken, and from then on there was a good supply of nutmegs on the market.

Drying

Before white men appeared on the plains, bringing the gun and the horse and other civilized trappings, the western Indian lived and

hunted in the manner of his ancestors. He stalked his game on foot and made his kill with arrows tipped with flint and clubs of sharp stone lashed with rawhide to wooden handles. The plains Indian was a stone age man. He had no metal nor pottery nor baskets, and he only knew the simplest methods of preserving food by drying. But he was a crafty hunter for all his lack of weapons and none excelled his skill in trapping herds of buffaloes. When a scout came in to camp with tales of a great herd approaching on the prairies the tribe made ready for a hunt, sharpening their flint knives, making leather bags, and laying hides upon the ground for butchering. Early on the morning of the hunt, one brave, more skillful than the others in the ancient art of decoy, donned a buffalo hide, his face entirely covered with the head, the back and legs dangling down his shoulders and his sides. Then the medicine man performed a tribal ceremony and sent him out to lure the herd into a trap.

Slowly this buffalo man made his way alone across the prairies. As he came nearer to the herd he went down on all fours and moved as one of them. Sometimes he rose up and twirled around on his toes to attract attention; then he would drop down on the ground and graze again. Soon a few bulls at the edge of the herd raised their heads to look at him. Then slowly he began to move away, back in the direction of the camp. A few buffaloes began to follow; then others came and he quickened his pace. Soon the whole herd was behind him moving faster and faster while the wily buffalo man led them back toward the



Darlington Library, University of Pittsburgh

INDIANS HUNTING BUFFALO

Darlington Library, University of Pittsburgh

INDIANS DRYING MEAT AND CURING HIDES

camp between two walls of brush and stone.

The Indians had built these walls in a V shape, wider at the entrance and converging gradually, so that the buffaloes would not notice them until they were well inside. But where the two walls should have met there was a gap, and just beyond this gap the edge of a steep cliff. Craftily the Indian headed the herd into this space between the walls. Nearly to the edge he led them — then quickly leapt the wall to safety. Other hunters, hidden behind these walls, jumped up and shouted, waving blankets and flinging their arms about to frighten the animals so they would stampede. The leaders stopped warily at the edge, but the wildly frightened herd behind pushed on and forced them over the cliff. Many were killed outright by the fall; some had broken legs and backs. Only a few escaped and ran away.

To finish off the kill and do the butchering was women's work; so the braves went back to camp and left the labor up to them. With great care the squaws peeled off the hides and set them aside to be cured and used for clothes and coverings and household goods. All the meat was then cut up and the larger pieces sliced into big sheets. These sheets were hung on willow frames, set up in the open, where

the meat would dry quickly in the hot sun and clear air of the prairies. During the drying process these strips of jerked meat shrank until they were about a quarter of an inch thick and became extremely brittle. The fat from the back was trimmed out, too, and dried to be eaten later with the lean.

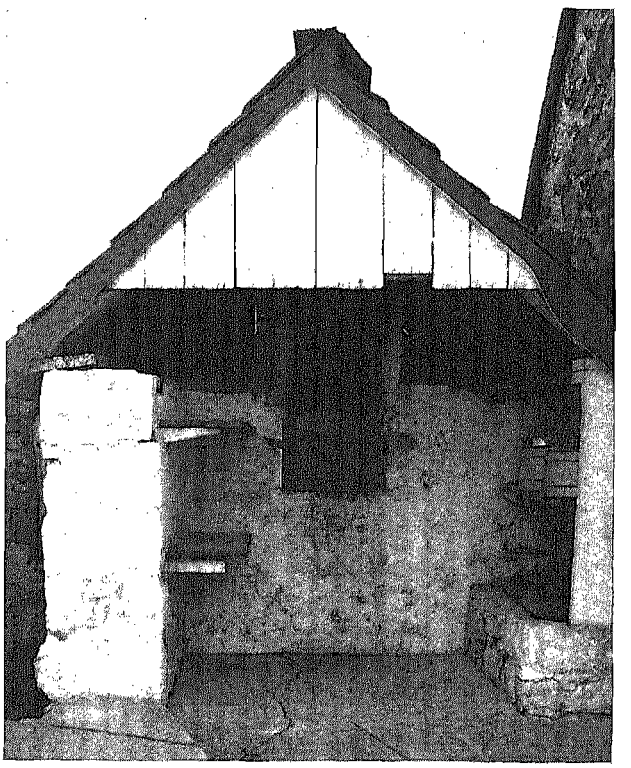
From this jerked meat the Indians made pemmican, the most important staple item of preserved food in their diet. For pemmican they dried the meat again, this time over hot coals, taking great care not to burn it. When the sheets were all as brittle as could be they laid them on dry hides and beat the meat with sticks until it was crumbled very finely. Then melted tallow was added to these crumbs and the mixture packed away in leather bags where it would keep almost indefinitely. When a finer quality was needed, fat, dry bone marrow, and pounded berries were added to the plain pemmican. Both kinds of pemmican could be cooked, or eaten cold when tribes were on the march.

Drying foods by removing the moisture is one of the simplest methods of preservation — so simple that even stone age people like the Indians knew how to keep food in this way. Prehistoric man spread his fresh speared fish in the sun to dry and held thin slices of meat over a wood fire in his cave until the moisture disappeared.

Arab tribesmen travelling over the desert by camel caravan carried the fruit of the date palm for food in their packs, dried because the date kept better that way and made a lighter load.

And it was not so very long ago in our own country that every village and farmhouse attic was stocked with a store of dried foods to be used the whole year round. Strings of snits and ropes of red pepper festooned from the rafters. Ears of corn hung in fat clusters and bundles of greyed herbs were tied to pegs on the wall — pungent herbs like thyme and sweet marjoram to season an old-fashioned stuffing; catnip and boneset to brew in tea as a cure-all for common ills.

In pioneer days almost every good-sized farmhouse had an outdoor oven. This was a solid, rough, stone structure separate from the house, often snuggled up against the summer kitchen. The stone walls were whitewashed and clean, and the top was covered with a



OLD OUTDOOR OVEN

separate overhanging roof of tile or shingles. Under the shelter of a roofed-in entrance were shelves for crocks and bake pans, long-handled iron hearth tools, and shallow wooden drying trays. The oven door was about waist-high, and the hearth was sometimes six feet deep with a curved ceiling two feet tall in the center. Several armfuls of wood were needed to build a fire that would heat up this big oven. Then the fire had to burn down and all the ashes be raked out with a long scraper before the oven was ready to be used for baking.

On this hearth the housewife baked countless loaves of bread, cakes and cookies, pies and pans of biscuits. When they were done to a turn she lifted them out on a long-handled peel and set them on shelves to cool. Then, in the slow, even heat still left in the oven, she dried all manner of fresh fruits in the summertime. Apples, peaches, pears and plums, blackberries, elderberries, cherries, huckleberries, raspberries — all the fruits that were cultivated on the farm or grew wild upon the hillside were dried inside this oven. The unpeeled, uncut fruit was spread in thin layers on shallow wooden trays; then the trays were pushed inside the oven and the heavy iron door was clanged shut. In the mild heat of the big stone oven fruit dried slowly and thoroughly, retaining much of its fresh piquancy and flavor. When the fruit was taken later from the oven it was threaded on long loops of string or packed in big cloth bags and slung on nails up in the attic to be stored until the fresh fruit was all gone. Then the snits and pears and berries were taken down and soaked in water to restore their moisture, and used in all the winter pies and cakes and cookies.

For millions of years nature has been using much this same method to preserve foods in the fields and forests. All grains and seeds have tiny dehydrating systems that dry the grain before it falls from the parent plant. Dried this way, grain can live through the hardest winter

CORN DRYING IN THE FIELD

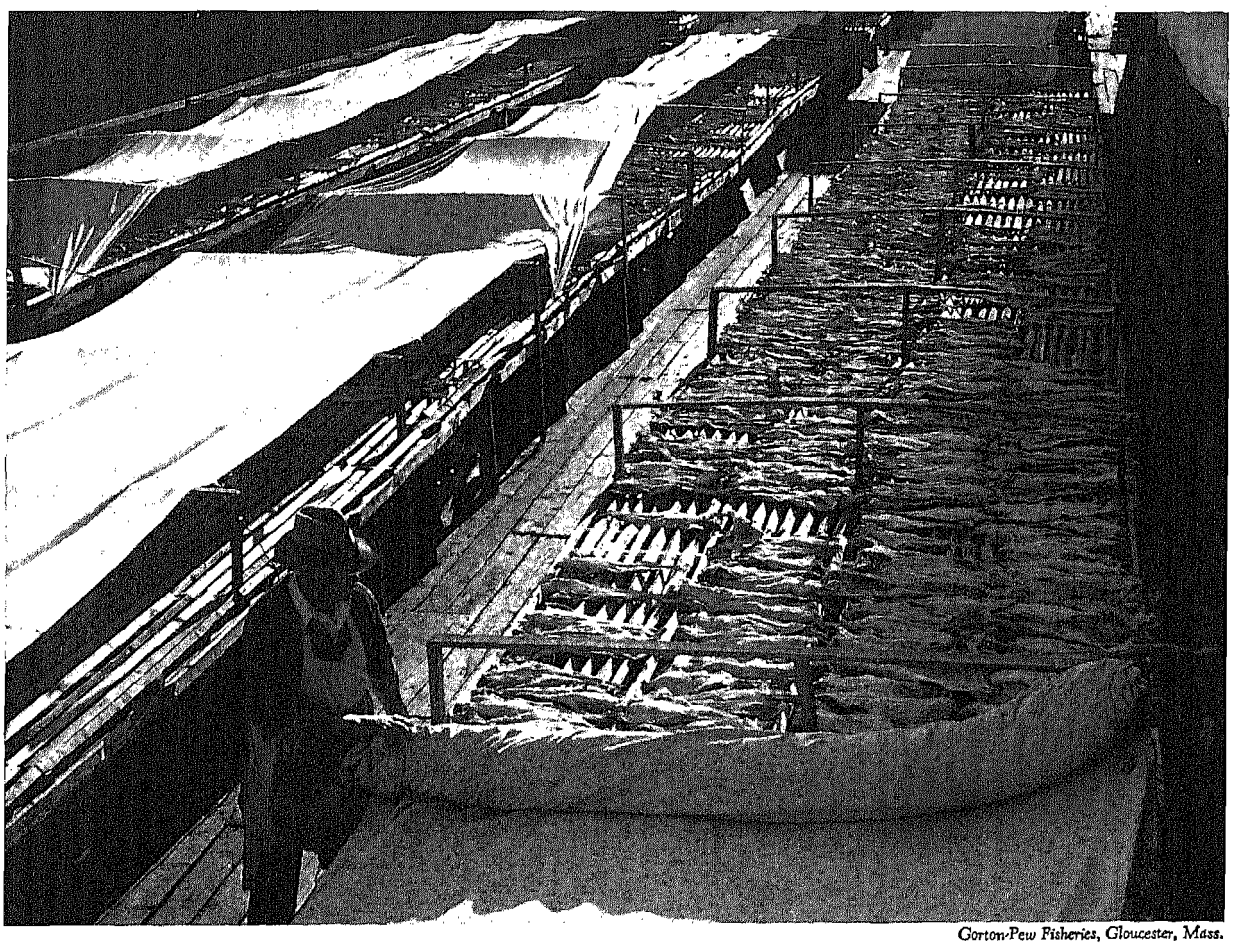
HOME DRYING SWEET CORN

and when spring comes sprout tender little green shoots deep in the earth to start a new crop. All man does is to take advantage of this natural drying system and harvest the grain when it is mature. You may have seen great golden shocks of wheat or corn standing in a field of stubble late in the summertime. That grain is drying in the shocks, and when it is perfectly dry the farmer will haul it into his barn or stack it in the field and later thresh it. All he has to do is store the grain, for nature does the rest of the preserving for him. Today almost all cereals, seeds, and nuts are handled in this manner.

You will remember, in our discussion of microorganisms, how often moisture paved the way for spoilage agents. Bacteria, yeasts, and molds all thrive in moist foods; so when the moisture is removed by drying these spoilage agents can no longer grow. In most drying processes very large amounts of water are removed. Six pounds of fresh apples, for instance, make only one pound when dried. If the dried food also contains a fair amount of sugar it keeps doubly well, since sugar is a natural preservative itself. For this reason, fruits, with their high sugar content, are very well preserved by drying; and fruits have been kept this way almost since the beginnings of time. Very ancient Oriental writings, hieroglyphics and scrolls, mention the drying of figs and dates and raisins. Later, European people added apples, prunes, apricots, and peaches until now the amount of fruit dried is enormous.

The dried fruit industry began early in this country when the Spanish mission fathers planted orchards and vineyards along the mild Pacific coast. The combination of fine fruit and perfect drying climate soon made this one of the largest industries in California. Right in the middle of great orchards, rolling for miles across the hills and valleys, there now are large patches of uncultivated land. These bare plots are used for drying fruit. Here trays full of thoroughly ripened fruit, hand picked and inspected with care, are placed in the sun to dry. Raisins are sun-dried here for ten to fifteen days, prunes for five days and other fruits for varying lengths of time. In some cases sun drying is supplemented by modern methods of artificial dehydration which have increased the effectiveness of drying as a method of preservation.

Dried milk is another product that is widely used today, probably not often in your own homes, though it is frequently recommended as a supplement to fresh milk where there is some dietary deficiency. Bakeries and food manufacturing companies are the largest users of these dried milk powders. By dehydration the weight of the milk is reduced 85 per cent, which gives an economically light powder of excellent keeping qualities. Eggs are dried in large quantities, also, and make a good wholesome food product used mainly in the baking industry. Yeast, too, is sold in the dried form,



Gorton-Pew Fisheries, Gloucester, Mass.

DRYING FISH

and dehydrated mushrooms are common in many European countries.

Drying has always been an important method of preserving fish. Cod and mackerel and many other ocean fish were dried and shipped to European ports soon after the first colonies were founded in this country, and great quantities of cod are still being dried today in many seacoast cities. Generally the fish are packed in brine as soon as they are caught off the Newfoundland Banks; then they are packed in kegs and shipped down to plants along the seacoast. Here they are laid out on wooden racks and tables to dry in the sun and strong salt breeze. Great care is taken that they dry thoroughly. If the weather changes suddenly they are covered quickly with long cloths and taken inside to dry. The Bombay duck of India, of which you may have read sometime, is simply a fish that has been dried after it has been allowed to spoil. Other kinds of fish peculiar to different countries are dried in ports all over the world and form a staple item in the diet of many people.

Drying, like several other forms of preservation, is satisfactory if the products are handled carefully. To keep in the best condition, many dried food products should be held in cold storage or packed in hermetically sealed containers.

Low Temperatures

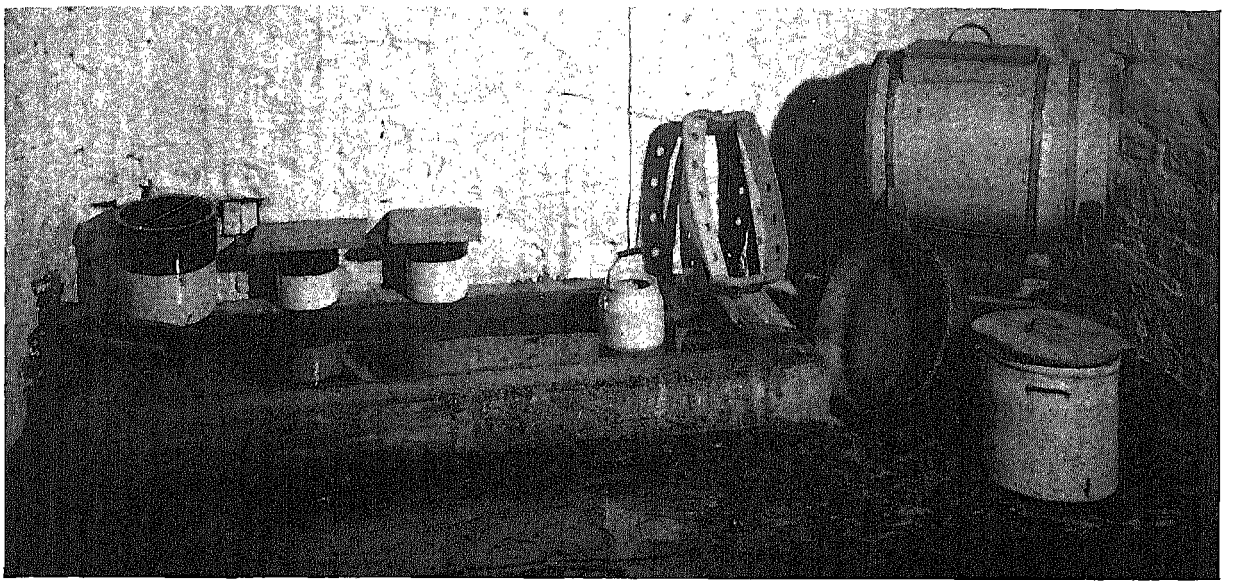
Did you ever visit a real old-fashioned farm? Then maybe you remember the springhouse where the food was kept fresh and cool and sweet. It was a small stone house nestled low against a hill. And there was a little stream of cool, clear water seeping from the side of the hill down to the springhouse below. Inside this house the water ran along a shallow trough of wood or stone or maybe it was concrete. And right there in the middle of the stream stood fat stoneware crocks and jugs, copper pans, and tin pails filled with milk, and cream, lard, and pats of yellow butter.

Not everyone has lived in the country, of course; so some of you may not know about a springhouse. But I'm sure you have all seen these foods tucked in the refrigerator at home. Both the old-fashioned springhouse and the new-fashioned refrigerator are doing the same thing; both are keeping foods fresh and wholesome for you in cold storage.

Hundreds of thousands of years ago our ancestors kept their foods that way, too, far back in the dark recesses of their caves where it was cool all the year round. Then many, many years later man learned to use the natural ice that formed on ponds and lakes and rivers to preserve his food. At first he cut a few cakes to use on his own farm. Then he began to cut a little more to sell in town. And after a time the ice cutting business grew until it became one of the great industries in our country.

When the streams froze over, thousands of men were busy harvesting the ice, just as a farmer harvests a crop of wheat or corn today. With special tools — plows, saws, hooks, and chisels — they marked the ice in blocks, cut it out, and floated it to shore. Then horses were hitched to the blocks or the strongest men pulled the ice up a steep wooden slide into an icehouse. You may have seen one of these old houses beside a stream sometime. There used to be hundreds of them along the Hudson and the Kennebec in Maine, and small lakes and mill ponds in the Middle West. They were long, rough board buildings made with double walls to keep the heat outside. Here great blocks of ice were packed down and covered with sawdust; then the building was closed till summertime. When warm weather came, huge cargoes of this ice were loaded in boats, shipped down along the seacoast, and sold in cities there.

At first people just packed food down among these cakes of ice or leaned dishes up



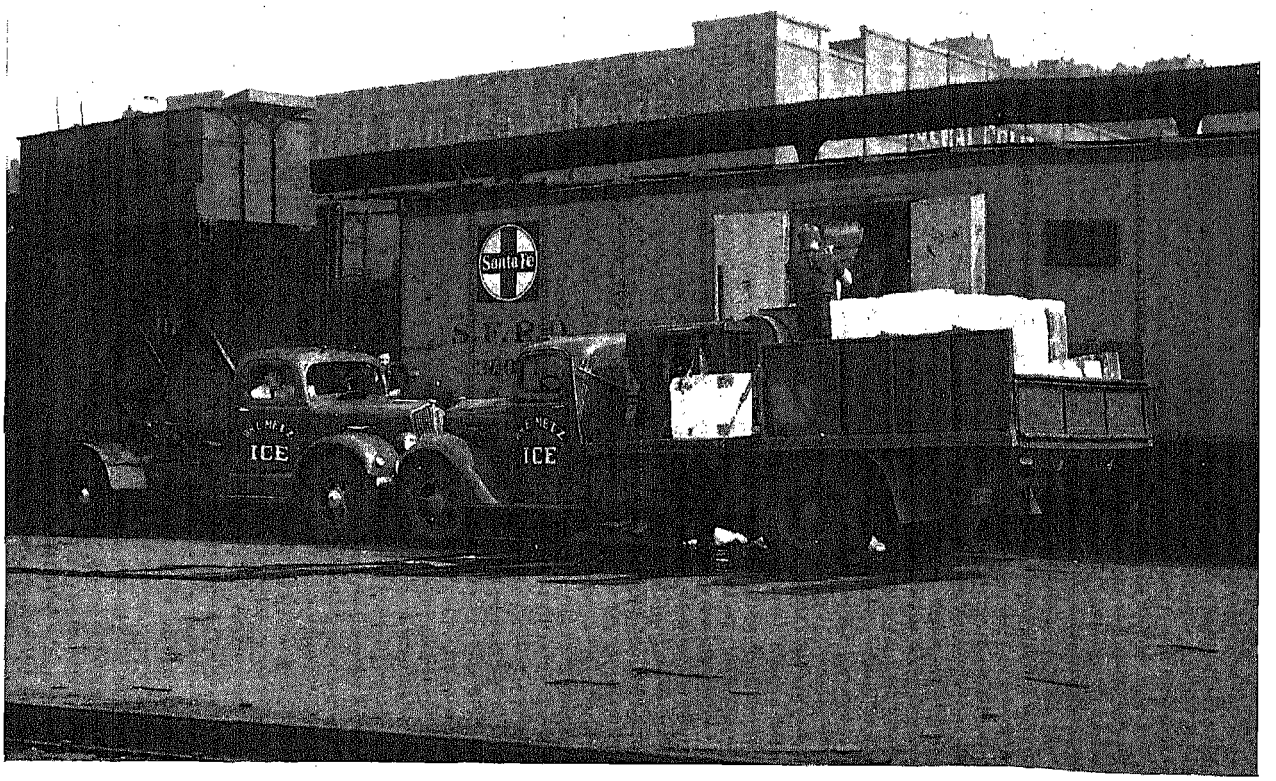
INTERIOR OF SPRINGHOUSE

OLD ICEHOUSE

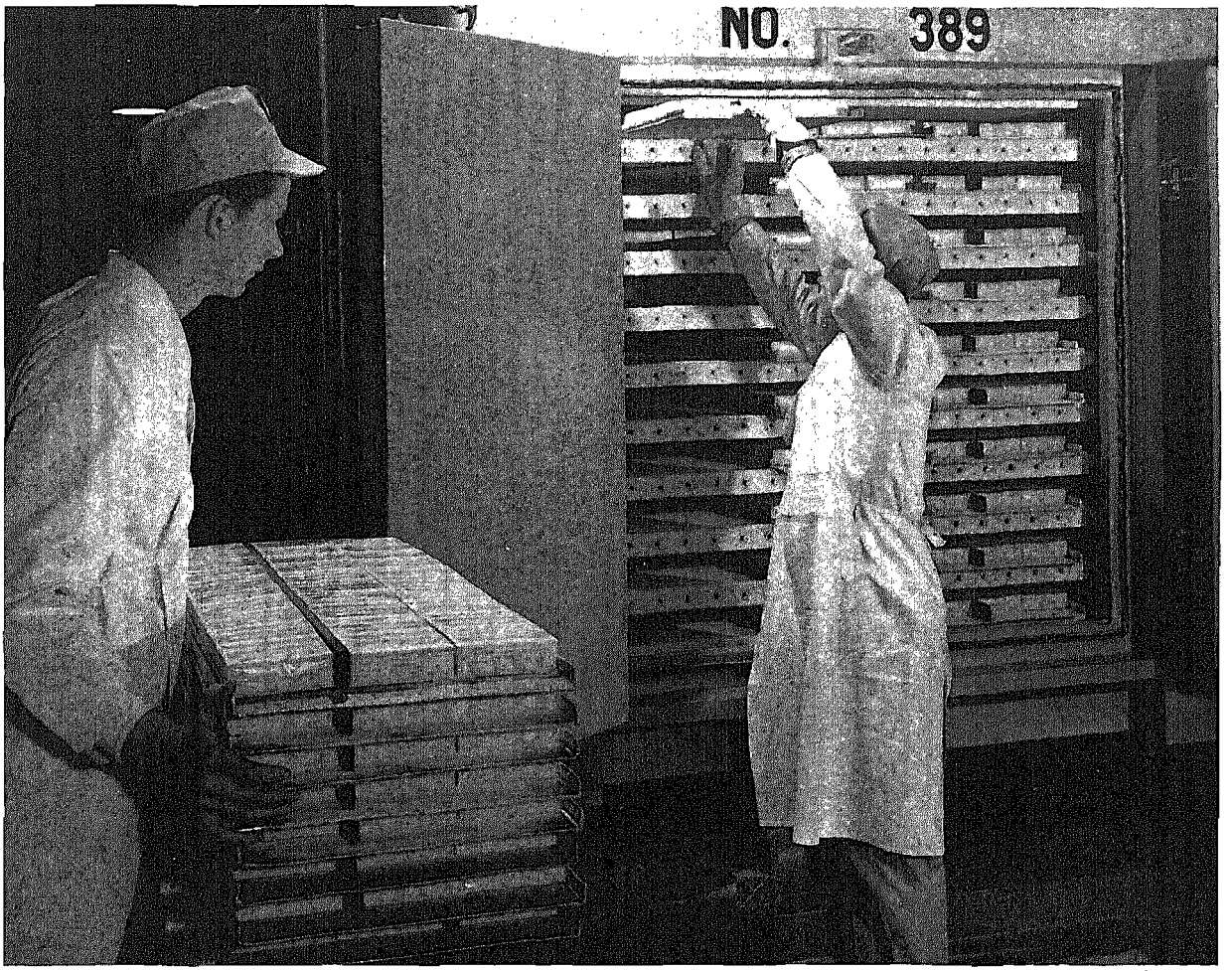
against them; then later someone discovered food would keep as well in an ice-cooled room. Soon small chambers, called refrigerators, were being built with racks up near the top where blocks of ice were placed. In this way natural air circulation was used to help chill the refrigerator. You know warm air always rises. If you have ever hung curtains on a summer day, you'll remember how much hotter it was up near the ceiling than on the floor. Now these new refrigerators worked on this same principle. As the air at the bottom of the refrigerator grew warmer it rose, passed over the ice, and was chilled again; so it moved on down to the bottom until it was warm enough to rise once more. This perpetual movement of air is called circulation, and it was this principle of circulation that made the first ice refrigerators successful.

Nearly seventy years ago engineers began to build refrigerators which were cooled mechanically instead of by natural ice. Way back in 1880 an Australian ship was fitted out with one of these new machines, packed with beef, and sailed around the world to England. From then on this new form of refrigeration was used widely for preserving foods and in many other forms of industry and commerce.

Many of us nowadays have some sort of refrigerator in our homes. Dairies use them to keep milk sweet until it can be delivered to your door. Packing houses keep meat fresh



ICING REFRIGERATOR CARS



Frosted Foods Sales Corporation

RACKING PRE-PACKAGED FOOD FOR QUICK FREEZING

in great cold storage chambers chilled this way. And you have all seen long trainloads of refrigerated freight cars hauling fresh fruits and vegetables far across the country. Even salted, smoked, and dried foods are stored in refrigerators to keep better.

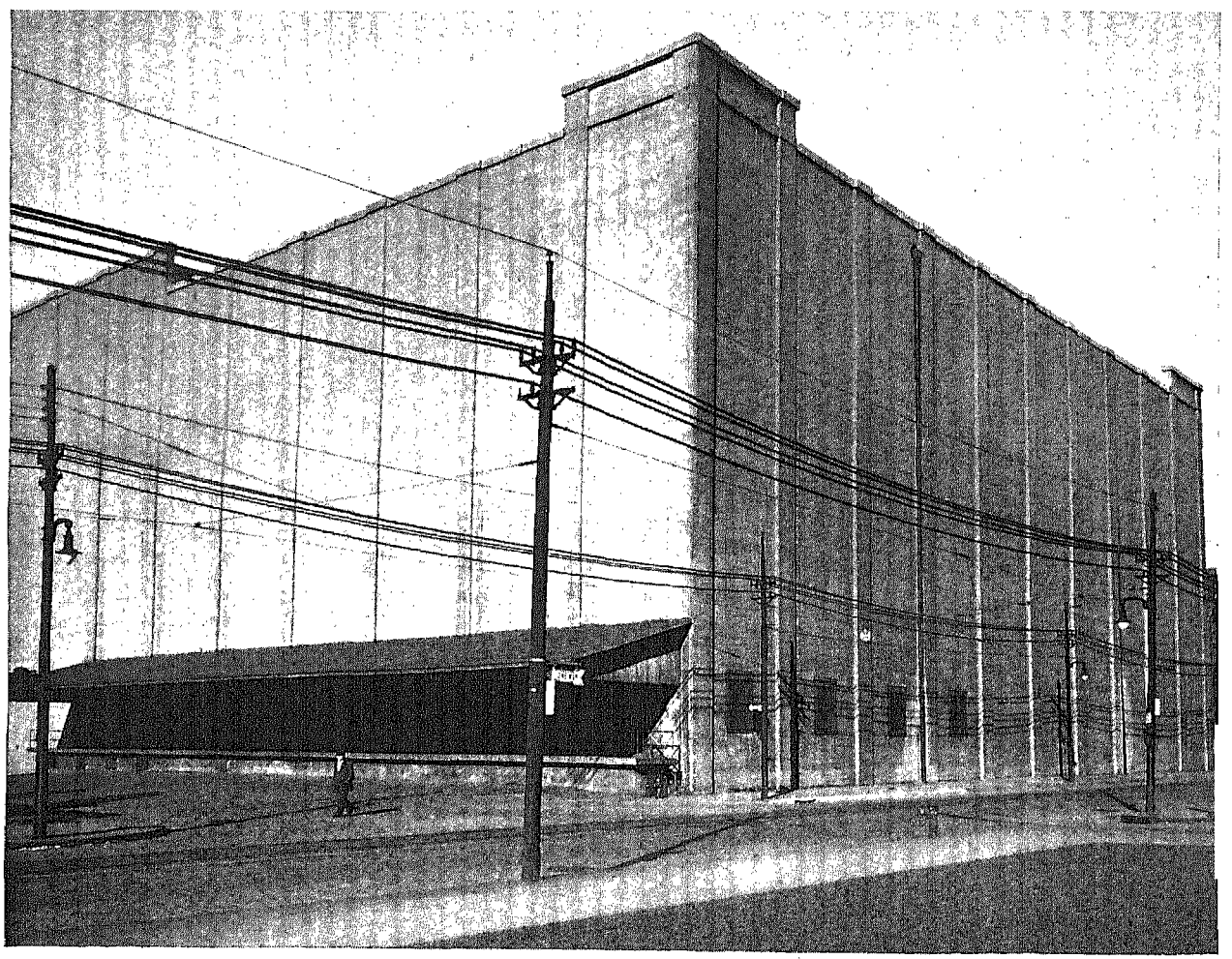
Mechanical refrigerators are used for many other things than food. Fur coats are put in cold storage during summer to protect them from moths. Films and paper for making photographs are kept in cold storage. Rooms are chilled by refrigeration, and florists keep flowers fresh and beautiful in cold storage. In fact, cold storage is now so important that people in big cities could live but a few weeks if refrigeration were cut off. Milk, butter, fruits, vegetables, meats, practically all our fresh foods would spoil long before we could get them from the country. You see, if you live in the city, your milk may have been brought from a farm hundreds of miles away in another state. Most of your meat comes from the ranges and packing houses in the Middle West. Fish is shipped from New England. And many fruits and vegetables have traveled to your table from southern farms and gardens and the great orchards of the Pacific. Refrigeration not only brings us food from far-off places, but it holds food from one season to another, too. You have all seen apple trees heavy with

ripened fruit in the fall, yet you can still get apples in the spring and summer, because cold storage keeps them firm and juicy for you.

Nowadays nearly every town and city has a great cold storage house. These plants are very much like the refrigerators in your own kitchens—only they are hundreds and hundreds of times larger. Heavy outside walls ward off the heat, and inside, these buildings are divided into many smaller rooms, so that different kinds of foods can be kept separate. To chill these rooms, along the walls and ceilings there are miles of pipes, through which a stream of very cold salt water flows.

Not all these rooms are chilled to the same degree of temperature. Most of them are kept above the freezing point, which means, if you place a pan of water in one of these rooms, it will be chilled, but not covered over with a film of ice. Others, though, are kept much colder; some at fifteen degrees above zero, and some as low as twenty degrees below zero.

In the last few years our engineers have developed a new method of refrigeration now used by many packers. This new method is called quick freezing and foods preserved this way are known as frosted foods. There is a very great difference between frosted foods and ordinary frozen foods. These new frosted foods are frozen very quickly at extremely low



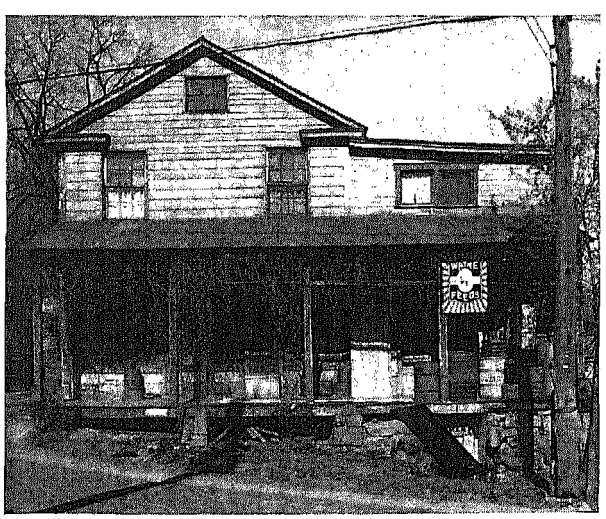
A COLD STORAGE PLANT

temperatures. In ordinary frozen foods the natural juices freeze slowly, forming large ice crystals which burst their cell walls just as frozen water bursts a bottle. But with this new frosted system the freezing is done so quickly the ice crystals that are formed are very, very tiny so the cell walls remain intact. When ordinary frozen foods thaw out they are apt to be soft and brown and wilted from the broken walls. But when these new frosted foods thaw they have the same fine flavor and appearance as the day they were harvested.

As long as cold storage foods are kept at low temperatures they last very well. But as soon as they are exposed to warmer, outside air they begin to spoil like any other food. And so, fine as it is, cold storage still is not the practical and permanent preservative method men have been seeking for centuries.

Canning

Here you see an old, old-fashioned country store. This weathered wooden building may have stood at the crossroads a hundred years or more. Maybe your own great grandmother bought bolts of calico and gingham here, and stocked her pantry shelves with tea and spice. Everything is jumbled on the counters, hanging from the rafters, and mixed carelessly together on the shelves.



OLD COUNTRY STORE

And now look at the modern grocery store on page 71. Here neatly placed in bins and boxes are fruits and vegetables from far-off farms. Loaves of bread are sealed in sanitary wrappers; cakes are packed in boxes; and meat is kept in long cold storage cases. But most of all we see tin cans. Rows and rows of bright tin cans filling the shelves that line the walls. Look closely and you will see each label indicates what is in the can and the amount it holds.

All the crisp vegetables will stay fresh here on the counter only a day or so. New bread and cakes must be delivered every day because the stock turns stale. And meats will keep just a short time in the showcase. But canned foods are not perishable like that. Air and sunlight do not touch them. Rats, mice, and insects cannot gnaw their way through the tin. Ordinary temperatures have no effect on them. All the microorganisms — bacteria, yeasts, and molds — are destroyed in cooking and the cans sealed against new growths. And when a can is opened the food is just as fresh and fine flavored as the day it was cooked. So you see, we have in canning the most successful method of preserving foods man has yet developed.

For thousands of years men have been seeking this safe and simple method of preserving foods indefinitely. It was hard enough, the way food spoiled, to keep a fresh supply in ordinary times. But during great national crises like wars the need was much more urgent. Armies on the march had to have good food and plenty of it, yet they could not take enough to live on or the people left at home would suffer. So it used to be, in order not to deplete the food supply of the people, that most armies ate salted meat, stale bread, and the fresh food they picked up as they moved along. On such a meager diet as this even a great conquerer like Napoleon could not prevent the toll

of heavy losses suffered by his army from inadequate food supplies and dietary diseases. Scurvy, a disease that comes from deficient diet, has probably killed more soldiers than ever died in battle.

Out of this great crisis finally came some good, however, for it stimulated the development of modern canning methods. While Napoleon was winning wars and lasting fame, the people back home, being underfed and hungry, too, began to be a restless and disgruntled nation. And so, to bolster their morale, the government organized a Society for the Encouragement of New Inventions, offering prizes for inventions that would present fresh opportunities to the people. Listed among these prizes was an award of 12,000 francs for a better method of preserving food; for the government believed that the condition of both the civilian population and the army would be immeasurably improved if only some more satisfactory method of preserving food could be developed.

Meanwhile out in Massey, a tiny town near Paris, an obscure confectioner had been experimenting with this very problem. Nicholas Appert had great skill with foods. He had been at times a chef, a brewer, a distiller, and

Wiggins Old Tavern, Northampton, Mass.

INTERIOR OF COUNTRY STORE

a confectioner. In all this work with foods he had been interested in spoilage problems. So for ten long years he toiled in a tiny kitchen back of his shop, patiently cooking and preserving.

After many, many experiments Appert concluded air was the cause of most food spoilage; so he developed a method of excluding as much air as possible. First he cooked the food and packed it in tightly sealed containers. Then he dropped them into a kettle of boiling water and re-cooked the food to preserve it.

No one thought of using tin cans in those days; so Appert worked with clumsy glass containers. Since most bottles were too narrow at the top to pack food in, Appert had to design his own wide-mouthed jars. Sealing the bottles was a problem, too. Cork made the tightest stopper, but the best quality came from the Pyrenees, was costly, and hard to get in quantities. Even the cooking equipment had to be specially designed for this new venture.

After all these details were settled Appert still worked five more years before his methods were perfected. The process, as he finally developed it, involved pre-cooking the food, bottling it in his own containers, wiring the corks in place, setting the bottles in burlap sacks, and lowering them into a big kettle, where they

Bayard Manor Grocery, Pittsburgh, Pa.

A MODERN GROCERY STORE

Courtesy Dr. A. W. Bitting, San Francisco, Calif.
NICHOLAS APPERT

cooked a second time. At first Appert had no idea just how long this second cooking time should be. He found it varied with different kinds of food; and it was only by painstaking experiments repeated over and over again that he arrived finally at the correct cooking times for many foods.

Even then, when bottles did not break or some other mishap occur, when every detail seemed satisfactory, still Appert had to store the food and wait a long time to learn the real results of his experiments. For spoilage would sometimes develop months later, though there was no indication of it when the bottles were first taken from the water bath. To test them even further, several batches were sent around the world on ships to see how they would stand the rough sea voyage and change of climate.

A lesser man would have given up long before this time. But Appert was a tireless research worker, and he conducted his experiments with the patience and precision of a sincere scientist. Fifteen years after he began his experiments Appert compiled his notes and presented them to the government. On January 30, 1810, the Minister of the Interior notified Appert his process had been carefully examined and the prize awarded to him. Before receiving the award, however, he had to publish his findings at his own expense and send two hundred copies of the book to the government.

This little book, *The Book For All Households or the Art of Preserving Animal and Vegetable Substances for Many Years*, marked the beginning of the great canning industry. Here Appert told how to preserve everything from the simplest foods to such an elaborate dish as, "a matelot of eels, carp and pike, garnished with veal sweetbreads, mushrooms and anchovy butter, the whole cooked in white wine."

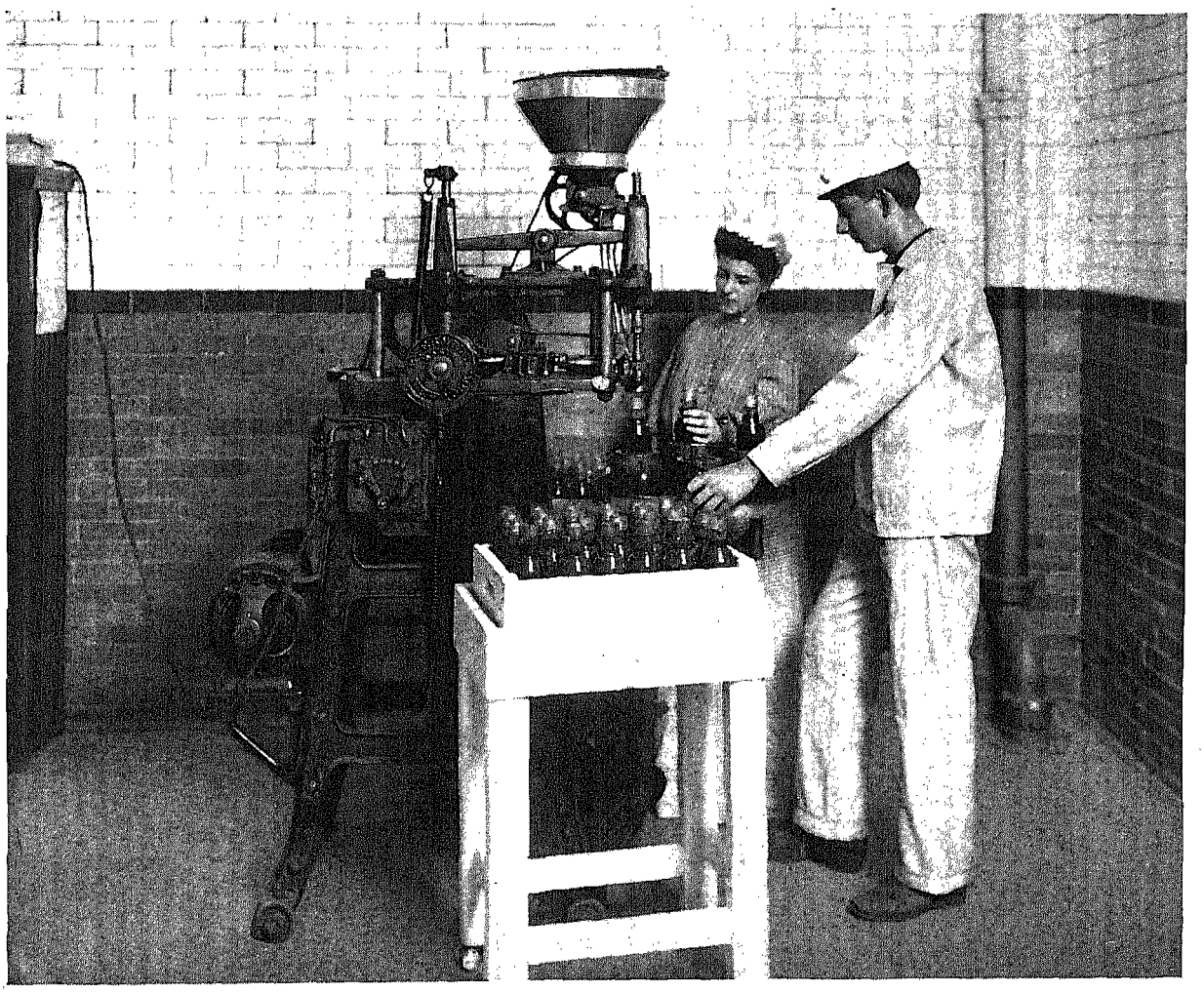
Appert used the award money to further his research and establish a food preserving business of his own. He spent so much on new experiments, however, that he died a poor man. But the business he established is still managed by his descendants and has long been famed for fine foods.

Now Appert's methods were sound but his containers were not. It was almost impossible to make the bottles airtight, and glass was so breakable and the roads so rough in those days that transportation losses were enormous. So about this time an English preserver, Peter Durand, after experimenting with the inferior glass available in those days, began making cannisters of tin to hold his foods. These tin cannisters were light and durable, but when they were re-heated after sealing they expanded and burst open. For a time it seemed that tin cans would not be satisfactory either. Then Durand experimented with them further, leaving a hole in the top of each can through which steam could escape, soldering

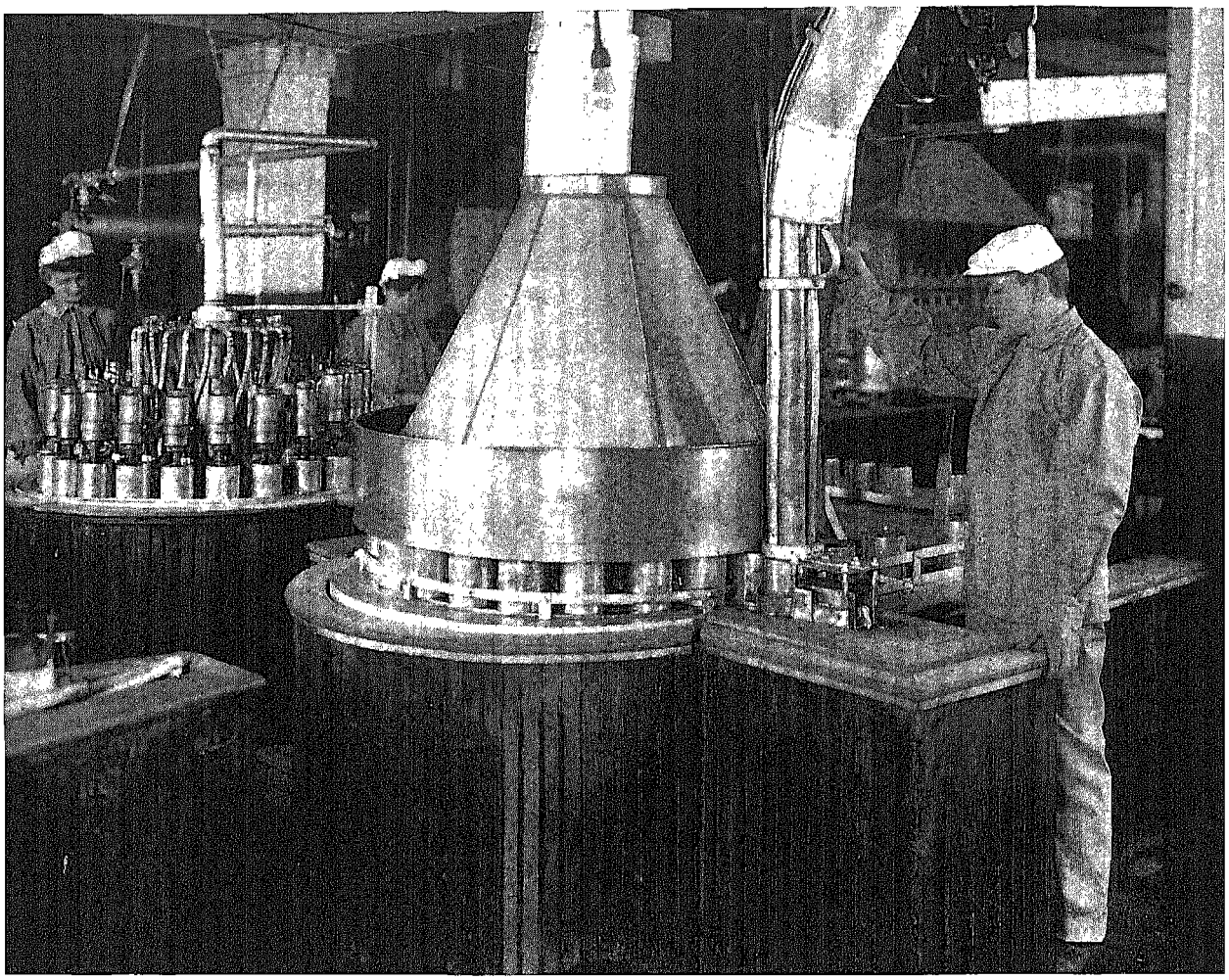
the holes closed after the re-heating process was complete. This method proved more successful though there was still considerable spoilage and many cans burst later while in storage.

In spite of all these difficulties more and more people soon went into the canning business. Appert described his methods so simply that in a very short time commercial canning was begun on a small scale all over Europe and even in America.

As early as 1817 a young Englishman, William Underwood, landed in New Orleans to start a canning business. He failed to get support here so he walked on up the country, through Baltimore and New York and all the way to Boston. There he founded the first food preserving firm in America. In a very short time he had markets in the West Indies, South America, and the Asiatic countries for his canned foods: jellies, seafoods, tomatoes, and processed milk. Shortly after this Charles Mitchell began packing fruits in Boston, too. Then Ezra Daggett and Thomas Kensett put up salmon, lobsters, and oysters in New York. Down in Baltimore the first cannery was opened in 1840. By 1841 the sardine industry was begun in Maine. The first food packing plant in the central states opened in 1860. Another began on the Pacific coast about 1856, and an Alaska factory was started in 1878. Nearly



A BOTTLE CORKING MACHINE IN USE IN 1904



CAN FILLING EQUIPMENT OF 1898

all these pioneer factories began by packing fish foods and considered fruit and vegetables just a side line of their business. You see, there was a profitable sea food market inland where fish were not available; so from the first, fish were packed extensively along the coast. As early as 1830 a Baltimore canner packed oysters and shipped them by Conestoga wagon over the National Pike to Pittsburgh.

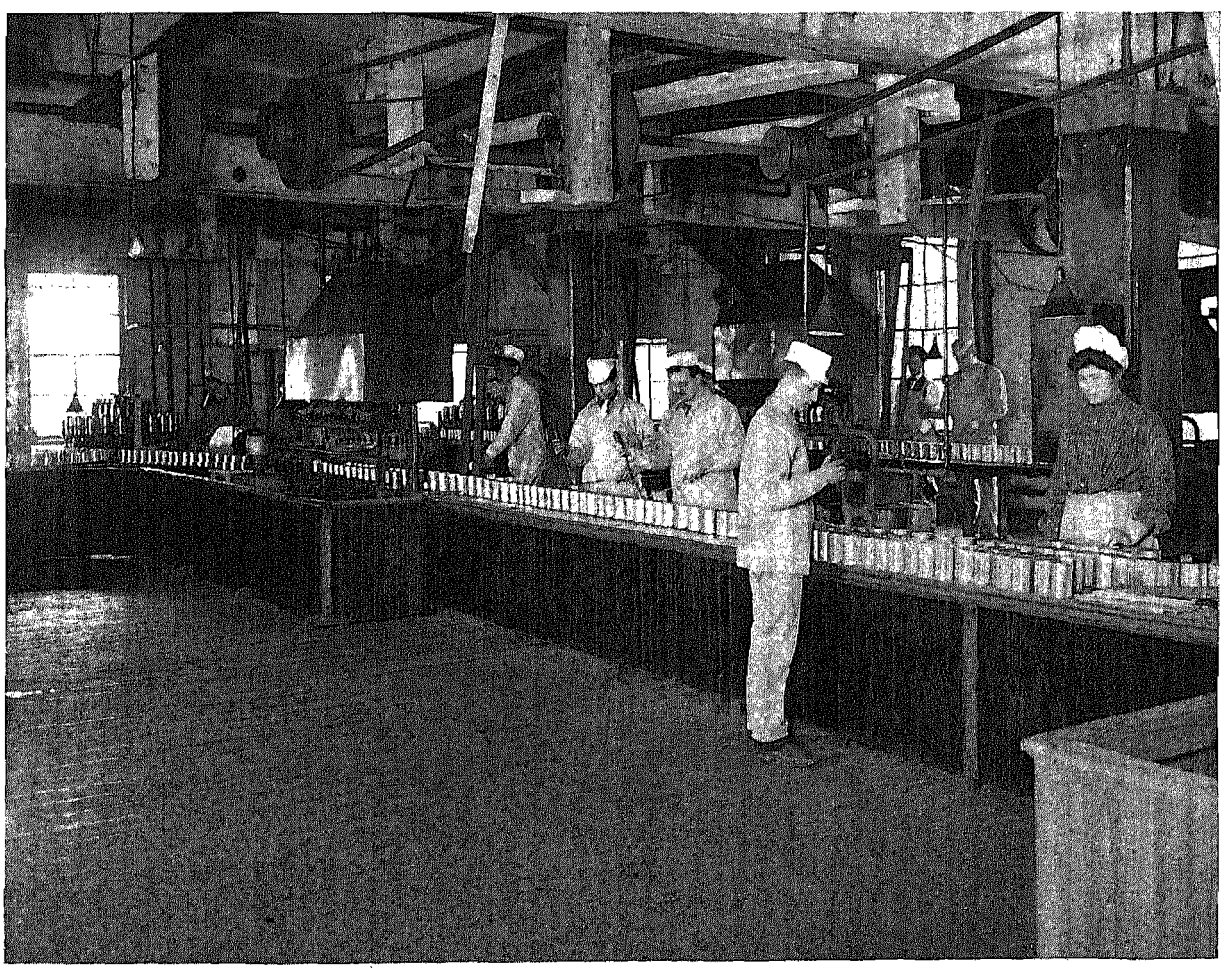
But in spite of this rapid development no one really knew why food that had been cooked, sealed, and re-cooked would keep. It was more often a matter of good luck than skill when any food kept at all. Even the most careful packers thought it merely a matter of keeping air out of the food. Then between 1850 and 1860 a great scientist of whom you have all probably heard, Louis Pasteur, studied bacteria and discovered these tiny microorganisms were the source of most of the fermentation and spoilage in food. In the course of his experiments he learned that heat would arrest or destroy the action of all bacteria, which, of course, explained why foods that had been cooked a certain time would keep. Heating foods in a closed container killed all the bacteria already in the tin, while the tight sealing prevented others from entering. The great science of bacteriology, so important to the canning in-

dustry today, developed from these discoveries of Pasteur.

Though it was thirty-five years more before most canners realized the direct application of bacteriology to their business, along in the nineties a few progressive concerns did begin to seek outside scientific advice. About this time a Wisconsin food packer consulted the state university about spoilage in his canned peas. Dr. Russell, a young bacteriologist who was sent to investigate their methods, recommended cooking the peas at a higher temperature to destroy the bacteria causing this spoilage. Before that time most canners thought higher temperatures would cook peas to a mush. But experiment proved Dr. Russell right, for the peas were perfectly preserved, and they remained firm and whole and fine flavored.

Then in 1896 Lyman Underwood, a grandson of the William Underwood who founded the first food factory in this country, and Samuel C. Prescott of Massachusetts Institute of Technology, appeared jointly before the Atlantic States Packers Association to read an important paper on the relation of bacteriology to the canning industry. This paper really aroused the interest of the food manufacturers and from then on scientific principles were applied more and more frequently to canning.

Mr. H. J. Heinz was the first food manu-



HAND SOLDERING OF CANS—1898

HAND LABELING OF CANS—1898

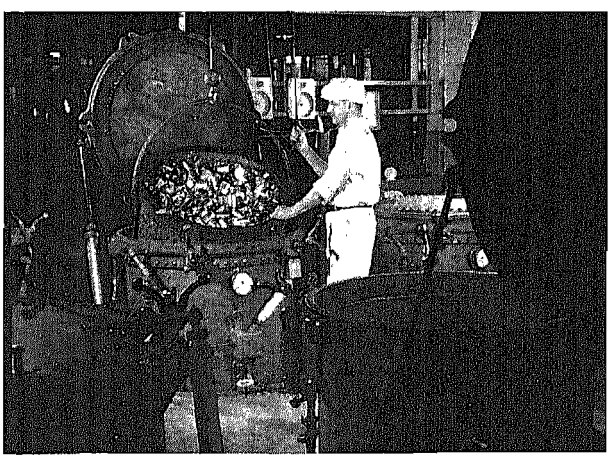
facturer to establish a research department within his own company. In the early 1900's bacteriologists began working with the Heinz Company, substituting scientific principles for the traditional methods used prior to this time in the food industry.

The bacteriologist could overcome some of the canner's difficulties, but there were still a few problems that required the co-operation of engineers and technical men to settle. For instance, while bacteria are destroyed at the boiling point of water, bacterial spores are much more resistant and must be cooked at this temperature six to eight hours or subjected to greater heat for a shorter time to be thoroughly destroyed. Of course six to eight hours of boiling was impractical, so it remained for the technical man to develop a method of raising the temperature and shortening the cooking time.

You all know that the boiling temperature of water remains at 212 degrees Fahrenheit, whether water is just burbling gently or bubbling away at a great rate. Long before packers understood the relationship of bacteria and bacterial spores to their business, they realized that higher cooking temperatures were needed to prevent spoilage. Even in the early days of the food packing industry several methods of raising temperatures were developed. Isaac

Solomon of Baltimore added salt to the water and raised his cooking temperature to 240 degrees Fahrenheit, but the salt solution proved to be so corrosive it ate holes clear through the tin where the solder was weak. Other manufacturers experimented with boiling in oil which raised the temperature to a much higher degree; however, this was a messy process and was not practical commercially.

As early as 1852 Chevalier Appert, son of Nicholas Appert, developed a form of the pressure cooker, a tightly closed container in which he could raise and control the temperature by means of steam. But it remained for an American, Mr. A. K. Shriver of Baltimore, to perfect and produce the pressure cooker on a



RETORTS

broad commercial scale. This pressure cooker, or retort as it is more generally called, is a large, heavy kettle with a tightly fitted lid that can be bolted securely closed. Filled and sealed cans are placed inside this pressure cooker, and, when the lid is closed, the temperature is raised and automatically controlled so that bacteria and spores are killed in a short time.

But still the canners' troubles were not over, even though they had identified bacteria as the cause of most food spoilage and learned to control them by raising cooking temperatures. For several years a cannery would have no spoilage trouble — then suddenly their whole pack would be ruined. It was a completely unpredictable situation. So again the scientists set about to solve the problem in their laboratories. Today so much data has been collected on these problems there is little, if any, trouble with the older, standard products. But whenever a new product is to be canned, all this experimental work must be done over again in relation to the new food, almost as tedious a task as Appert's first research.

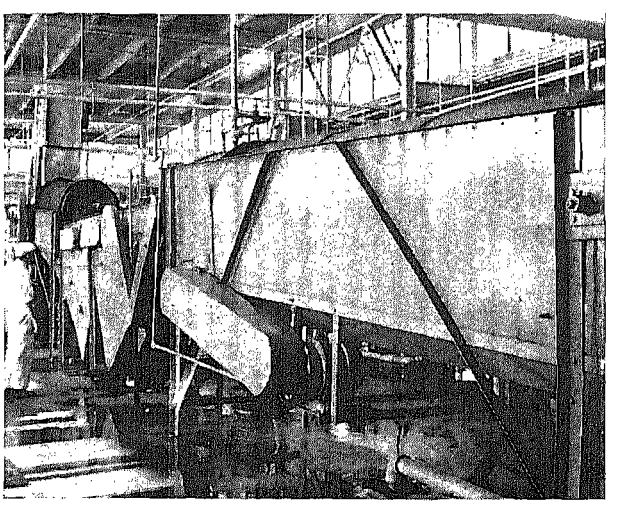
In the meantime, while scientists and engineers were improving the technique of preservation, the canners worked to perfect their containers, too. The first cans, you will remember, were all made expensively by hand: hand cut, hand soldered, and hand sealed. A thin piece of tin was cut, bent into a cylinder, and sealed with solder. Then discs were cut for the tops and bottoms, and soldered on the ends of these cylinders. A hole was left in the top of each tin, and after the can had been filled through this hole, a small piece of tin was soldered over the can and sealed tight.

At first a skilled tinsmith could make only fifty or sixty of these cans a day. Then better soldering methods were developed which hastened the process a bit. But not until some expert developed a machine for sealing the tins was it possible really to speed up production and reduce the cost of these containers. In forming the body of the can this new machine crimped or folded one edge over the other. To assure tight sealing, a rubber compound was applied around the top and bottom discs. Then the ends were crimped on, giving five thicknesses of tin with a layer of rubber in the center of the seam. Later a lacquer lining was developed for the inside of the tin, thus affording double protection to the consumer. This lacquer lining preserves better the fresh color and fine flavor of the product. Now instead of making fifty or sixty cans a day one of these

modern machines turns out three hundred cans a minute.

The first canned foods were so costly manufacturers only thought of preserving foods as out-of-season luxuries. But as the demand for these new foods increased packers realized there would be a great market if they could reduce the cost so that canned foods might be used at every meal. You see, in the beginning all commercial canning was done entirely by hand just as your mother would do if she put up canned foods in her own kitchen today. But by using hand labor this way, the manufacturer's costs were just as high as those of the housewife; so if he was to succeed in this new venture the manufacturer had to find some way of producing as fine canned foods as the housewife, at less cost. And so he began to replace hand operations with machines to speed up production and to reduce manufacturing costs, until today almost all canning is done swiftly and efficiently by machinery.

There are machines now for almost every operation; machines for handling products in the field, machines for cleaning, cutting, and cooking the food, machines for filling and sealing it in tins. So simple an operation as washing the fresh food is a very complicated process



WASHER FOR LEAF CROPS

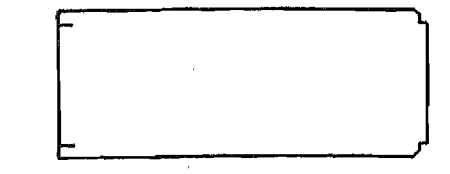


FIG. 1

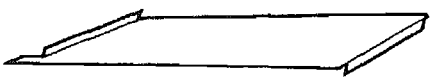


FIG. 2

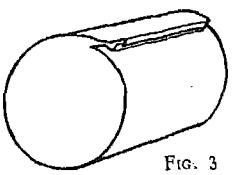


FIG. 3

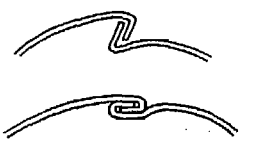


FIG. 4

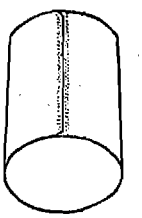


FIG. 5

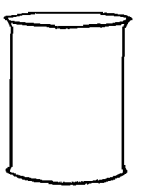


FIG. 6

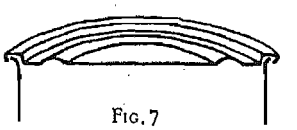


FIG. 7

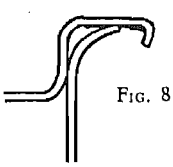


FIG. 8

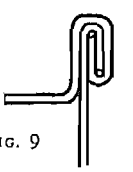


FIG. 9

FIGURE 1 — Flat tin plate cut to size and notched for the body of the can.

FIGURE 2 — Notched ends are hooked.

FIGURE 3 — "Former" bends plate to shape of can.

FIGURE 4 — Hooked ends pressed together to form side seam.

FIGURE 5 — Solder applied to outside of seam.

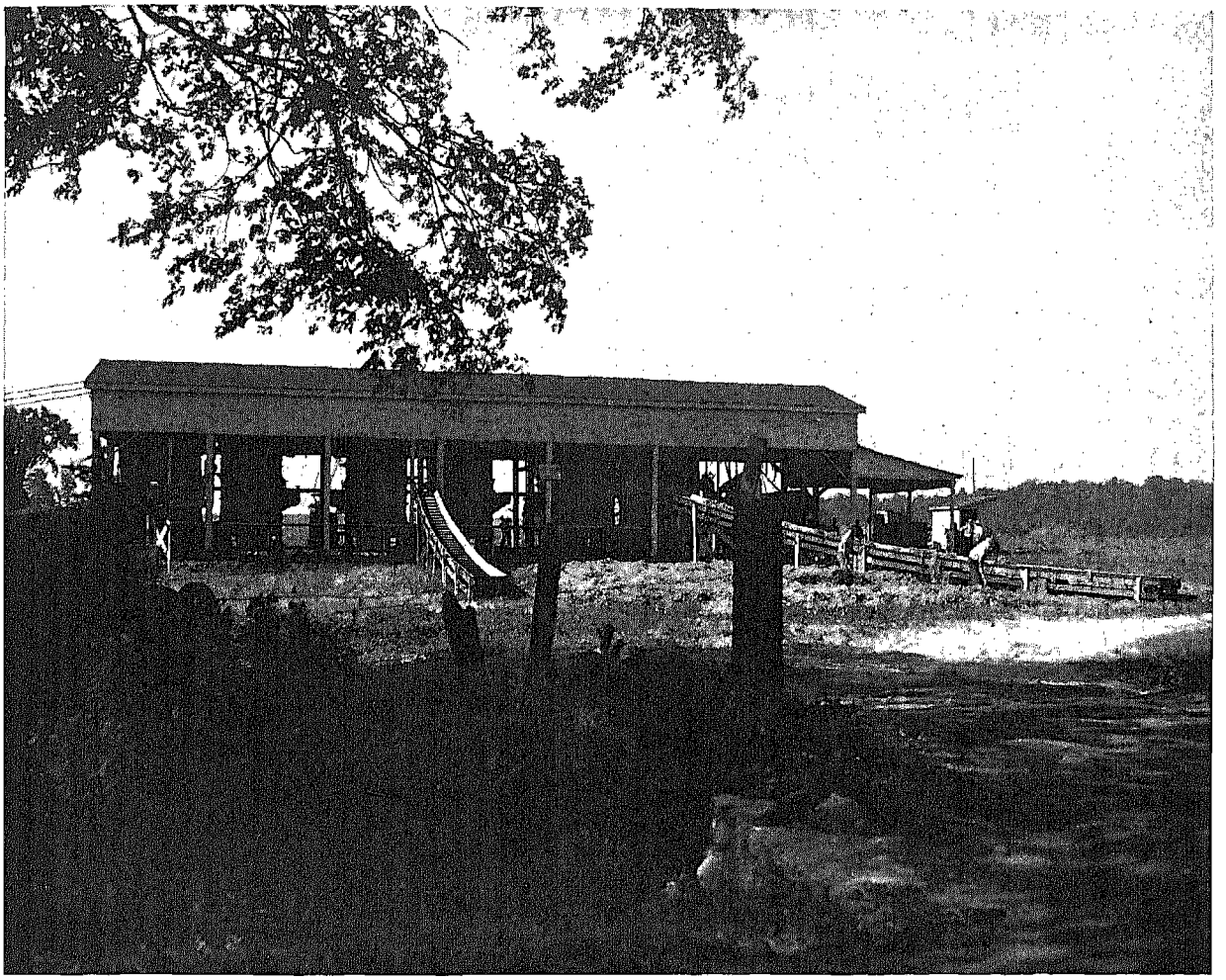
FIGURE 6 — Ends of can flanged.

FIGURE 7 — Top and bottoms stamped and rubber sealing compound applied to outer groove.

FIGURE 8 — Ends attached to side in double seaming machine.

FIGURE 9 — Curled ends and compressed sealing compound given air tight joint.

Illustrations Courtesy of American Can Company



A PEA VINER

in a canning factory. Some products are soaked first, and some are soaked and agitated. Others are sprayed with streams of water, sometimes very tiny streams and sometimes with strong pressure sprays. Then there are vegetables that must be washed in big, revolving, perforated cylinders. And all these processes require great quantities of pure cold water. Even the bright new cans are washed, as an extra precaution, just before filling.

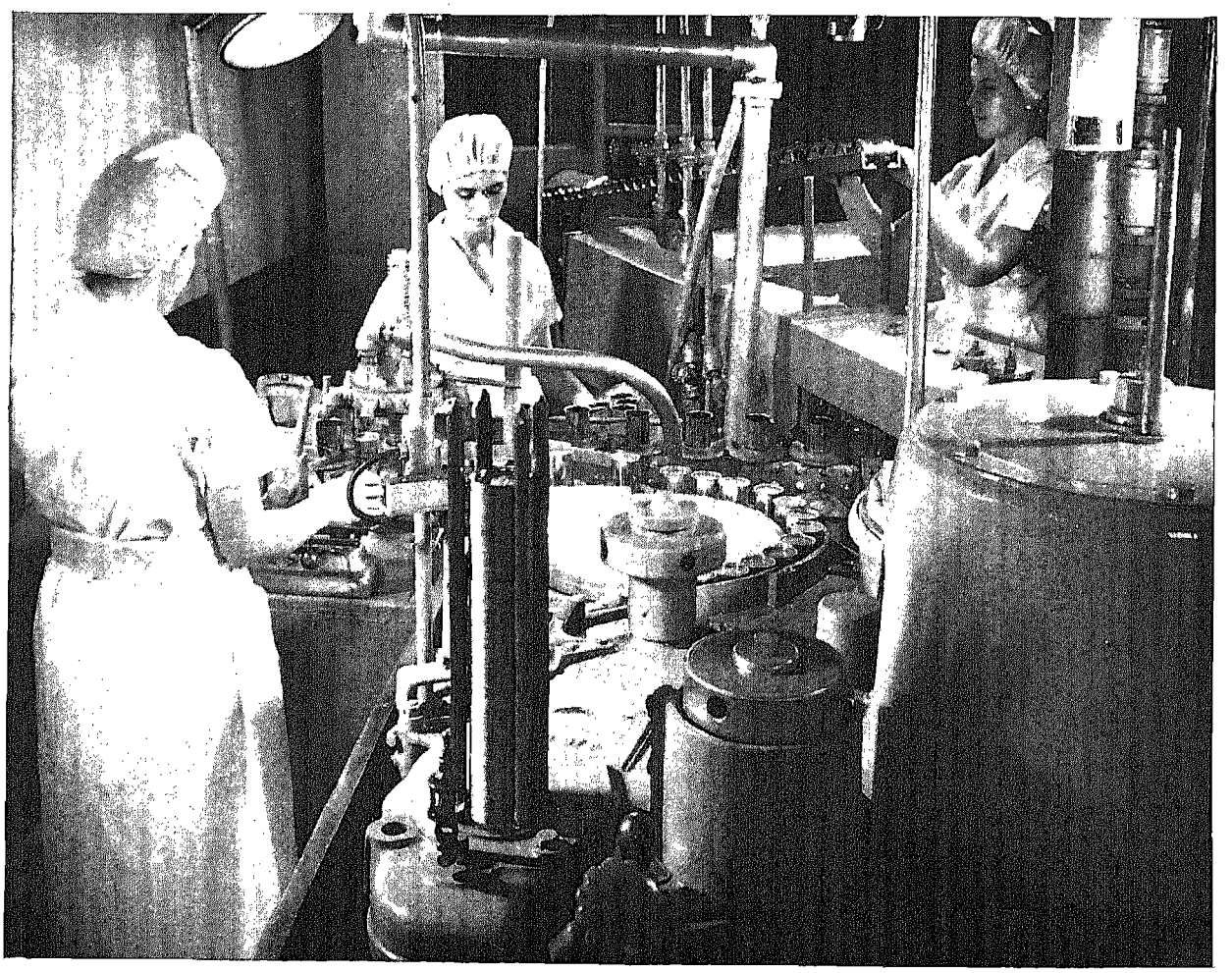
So many different kinds of machines are used we would never have space to tell you about them all. Some are used in the field and some in the factory. Peas, for instance, are cut in the field by a mowing machine, just like hay; then they are raked and loaded on trucks immediately and taken to the viner. This viner is a large machine rather like a thresher. It opens the pods, shells out the peas, and separates the peas from the hulls and vines, doing the work of about two hundred people in a few operations, and doing it more quickly and efficiently, with less injury to the peas, than human hands could do.

Corn, too, is fed into a machine in which the ears are husked, stripped of silk, and the grains are all sliced off without being touched by hands. Pineapples are fed into machines that peel off the hard outer shell, cut off the ends, and cut out the cores before they go to

another machine to be sliced. Even beans that have been carefully screened and sorted are passed under a photo-electric cell to eliminate imperfect beans not visible to the keen-eyed inspector.

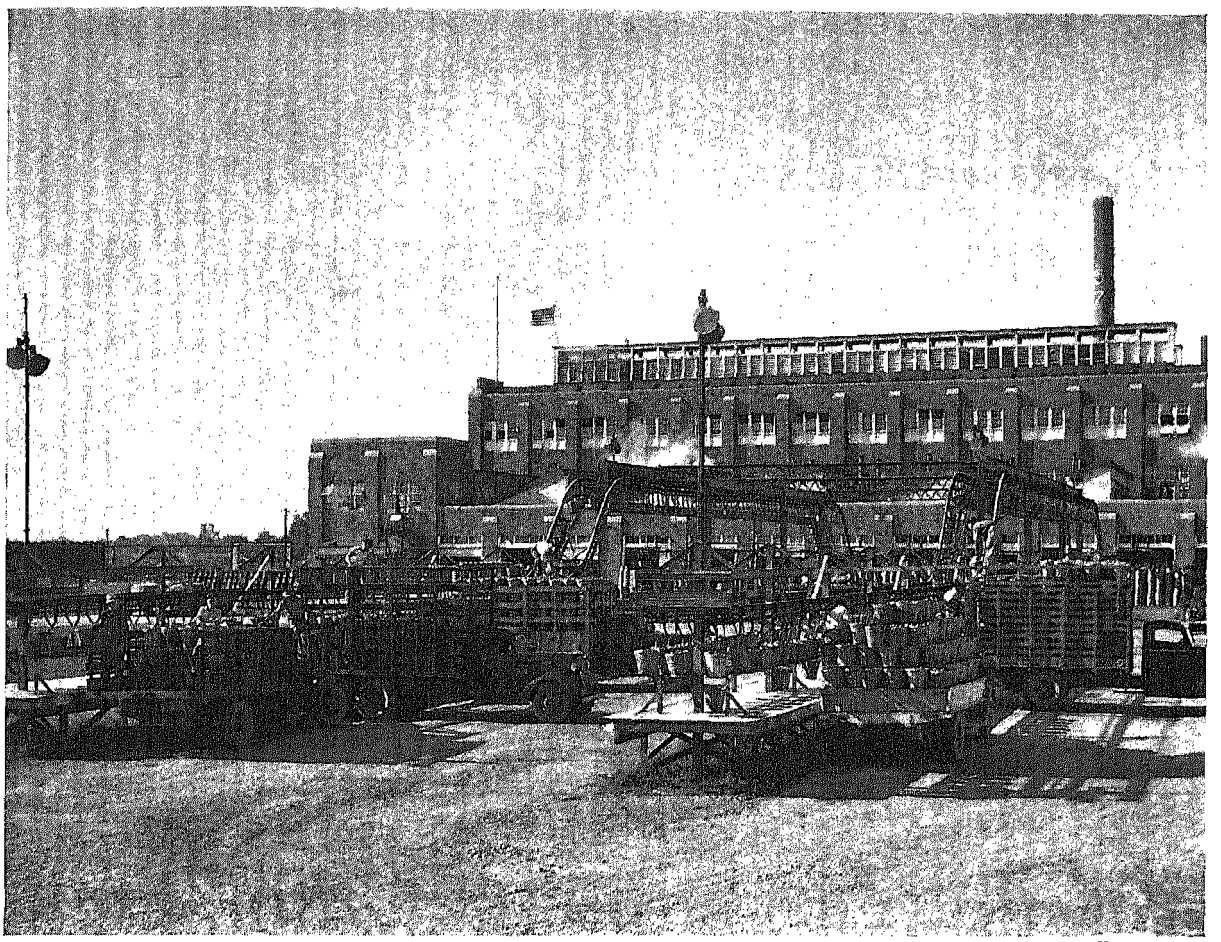
But the most remarkable machine of all is one used now in the salmon industry. Cleaning and preparing salmon by hand was a tedious job that used to be done entirely by Chinese labor until Mr. A. K. Smith, in 1903, invented a machine known as the "Iron Chink" that could do all these tasks by itself. In a continuous series of operations this new machine cut off the heads and tails, split the fish open, cleaned it, washed it, and threw it into hot water. This amazing machine even adjusted itself automatically to the size of each fish as it came along.

Besides all these machines for preparing foods there are many different kinds of machines for filling cans and sealing them. These filling rigs, as they are called, measure the exact amount of food needed, drop it into each can automatically, and pass the cans on to other machines where they are sealed and sterilized. Connecting all these machines like a giant artery is a series of conveyors, long belts or rollers that move from one machine to another making one swift and single operation of the whole complex process. Food comes in from



H. J. Heinz Co.

A FILLING RIG



H. J. Heinz Co.

CONVEYORS FOR UNLOADING TOMATOES AT RECEIVING STATION

a receiving platform on conveyors, moves to cleaning machines, filling machines, sealing machines, sterilizing machines, labeling machines, and on into cartons for shipping. These conveyors move so rapidly they make it possible to reduce the cost of manufacturing and insure a superior product by sealing in all the good freshness of the food as soon as it comes from the farm.

From Appert's small start a little over a century ago, canning has grown until now it is a giant industry. In 1904, when a census was taken of the business in this country, it was found there were 34,500,000 cases of canned goods packed annually at a value of $78,000,000.00. By 1935 this figure had increased to 196,796,000 cases with a value of about $640,000,000.00. And this number, you will notice, is reckoned in terms of cases, not cans. A standard size case may contain anywhere from six to a hundred cans depending on the size of the cans and the type of food packed in them. So you see, it is safe to estimate there were somewhere between nine and ten billion cans packed during that year alone.

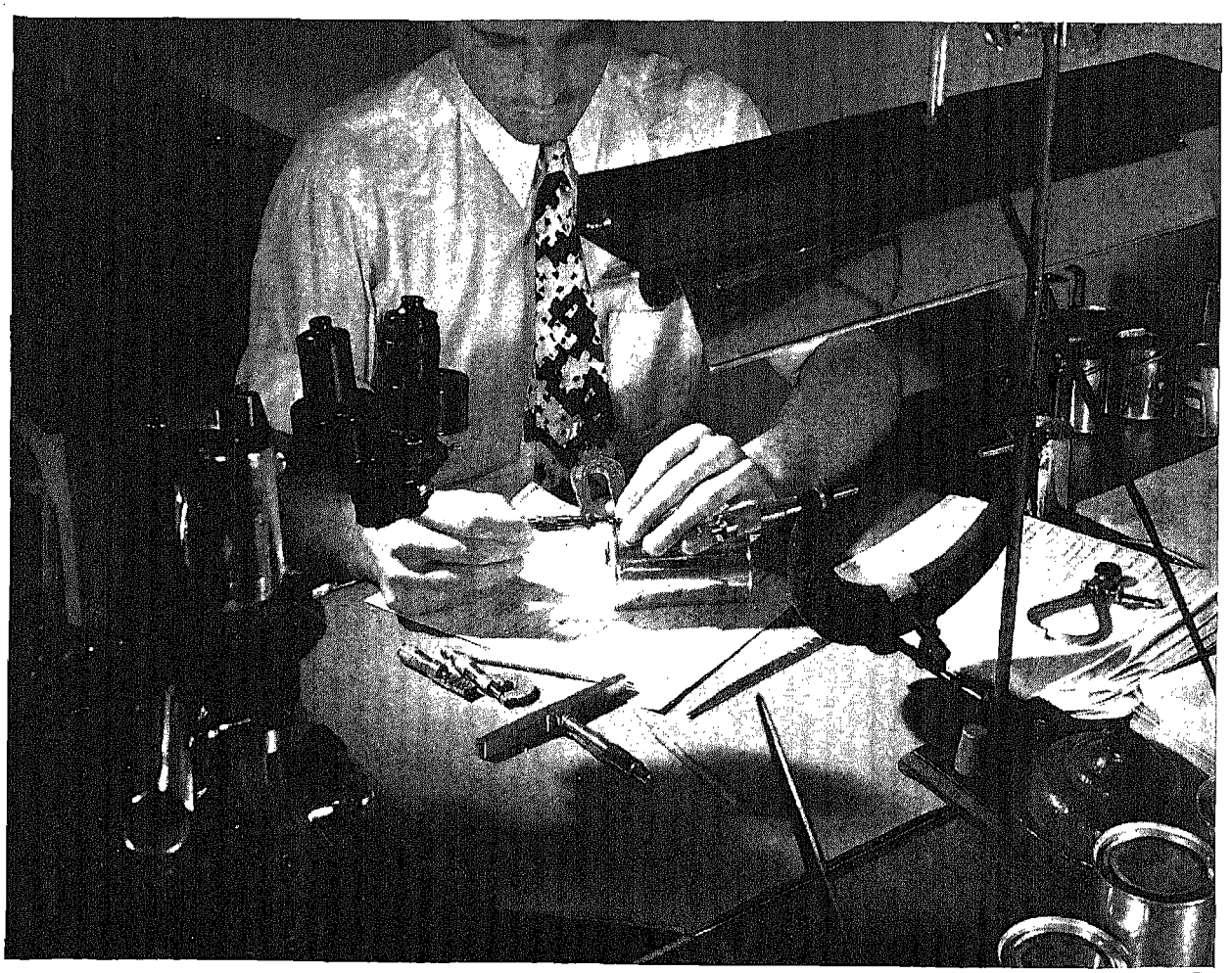
Not all of these cans were packed in one locality either. In order that the freshest and finest food may be packed in their cans, manufacturers have built their factories in communities where the best foods are grown. In this way the industry has spread all over the country until now there are canneries in forty-

four of the forty-eight states. Some foods are grown in just one or two localities. Pineapples, for instance, are packed chiefly in Hawaii. But such crops as peas and tomatoes are grown at many points scattered over the whole United States.

In the beginning, you remember, just a few foods were packed in cans — fish and fruits and the commoner vegetables. Now this number has grown with experiment and public demand until there are between 350 and 400 different kinds of canned foods on the market today.

In spite of the painstaking research and modern improvements in canning there still remain certain prejudices, we might almost call them superstitions, about canned foods. People are generally suspicious of new things until they are familiar with them; this is specially true of foods. At one time, you know, people were afraid to eat the tomato because it belonged to the poisonous nightshade family. The potato, too, was regarded with distrust for the same reason. And in the early days of canning many people were afraid also of the new foods packed in tins. Some of their outmoded ideas linger with us still.

There is, of course, the notion that the metal of a can will poison food by contact with it. Now tin cans are made from thin plates of



H. J. Heinz Co.

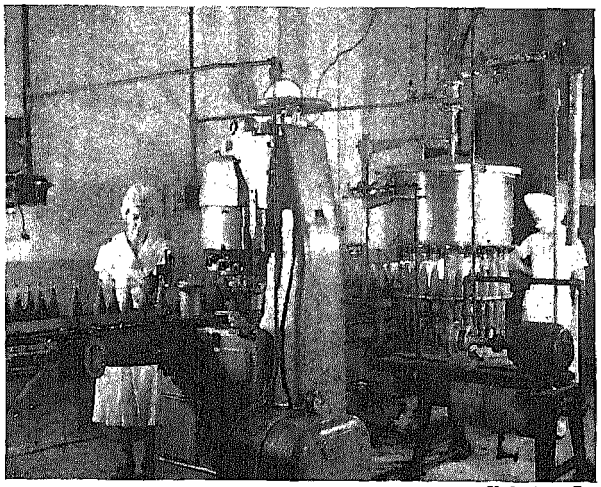
CANS BEING TESTED IN LABORATORY

iron coated with very pure metallic tin. In some cases, where the food might be slightly discolored by tin, an enameled lining is baked on the inside of the can, which ordinarily protects the food from any contact with tin. It is physically impossible, however, for the coating of tin always to cover perfectly the layer of iron; so there may be rare cases where food does come in contact with the iron. But even this is absolutely harmless, for iron is a necessary item in our diets and small amounts can cause no trouble. In regard to tin, the United States Department of Agriculture recently conducted an investigation on this matter and found that the amount of tin in canned foods is so slight as to be entirely harmless.

Then again, there is an old fallacy that food must be removed from a can as soon as it is opened or it will spoil. This is not true. Food in an opened can will not spoil any more than it does when removed to an open dish or jar. If allowed to remain in a warm room, both will spoil and at the same rate. However, if properly cared for by placing in a cold refrigerator, the food will keep equally well either way. The United States Department of Agriculture has conducted extensive experiments on this and verifies the statement.

Many people also think all canned foods still contain artificial preservatives. This is not the case either. Cooking by means of heat is the only method used to preserve most canned foods nowadays. A little salt or sugar is added to some foods to bring out the flavor, but they only serve incidentally as preservatives.

Then there is the legend that only left-over and inferior products are used in canned foods which, again, is quite untrue. In nearly all cases choice foods for canning are grown under contract especially for the canner. They are picked at the peak of the season, rushed to nearby factories, and canned immediately.



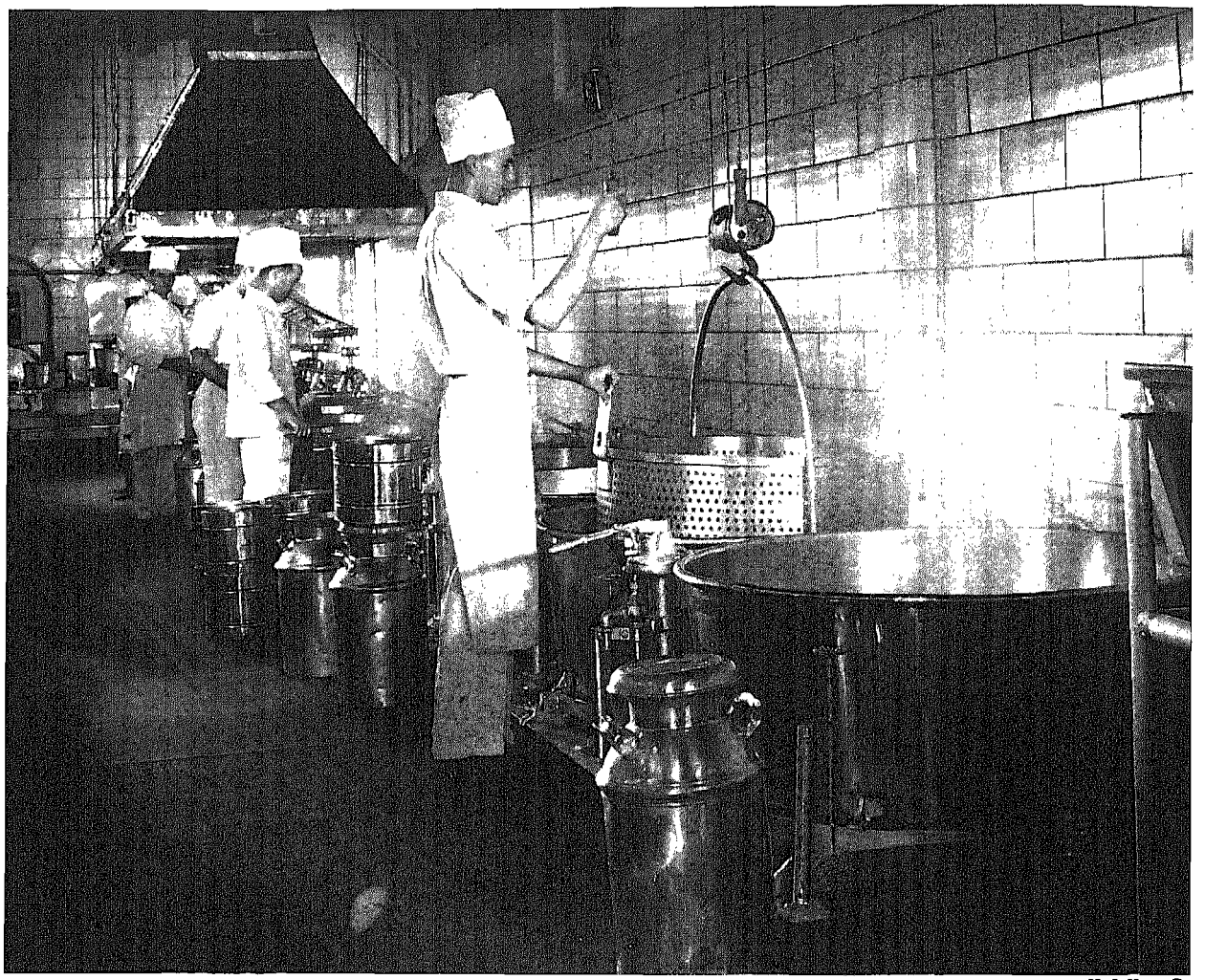
H. J. Heinz Co.

FILLING KETCHUP BOTTLES

Canned foods do not lose their nutritive value through processing either. A great deal of research has been done recently on the retention of the vitamin and mineral content in canned foods, and as a result of this, cooking methods have been perfected in which the nutritional loss in most foods is so slight as to be negligible. In fact, more of the vitamin content is retained by commercial canning methods of cooking in closed containers than by ordinary home methods. With such important products as strained foods for infant feeding, packers are making a constant effort to increase the nutritional value of the food by growing varieties of fruits and vegetables with higher vitamin contents and by improved methods of handling and processing.

While most canned foods are cooked by means of heat to preserve them, lately a new method of preservation has been developed in which all the air is taken from the can. This method, which is called vacuum-packing, is used chiefly with dry foods. You have all seen vacuum-packed coffee. Nuts and dried fruits are packed this way, too, and will retain their flavor almost indefinitely by this method.

Nowadays cans come in a great variety of sizes and shapes. The small-sized family may have a small can — the large-sized family a



H. J. Heinz Co.

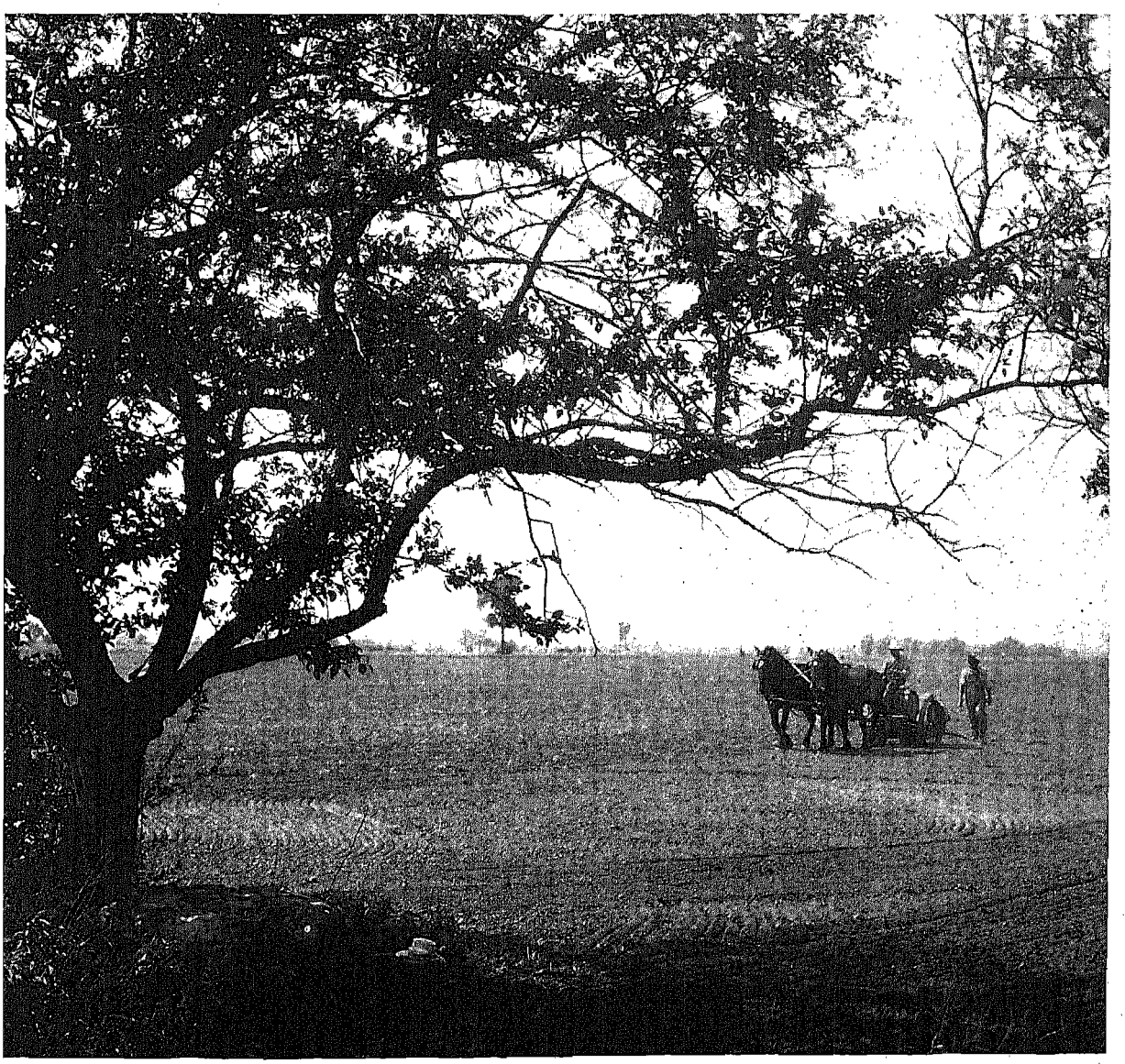
KITCHEN IN CANNERY

larger can. Hotels and restaurants often find very big cans more practical for their purpose. Different shapes have been adapted to certain foods, too. While the familiar round can serves for most foods, there are some that pack best in special shapes. No doubt you have all seen sardines done up in flat oval tins, asparagus in square tins, and salmon steaks packed in large oval cans.

And so you see how completely modern canning methods have answered man's great need for perfect preservation. None of the known spoilage agents affect canned foods. Sunlight, air, temperature changes, water, enzymic action, animal and insect pests, micro-organisms — none of these can damage well-canned foods. Under modern scientific methods the consumer is assured of the choicest quality of foods, grown under careful supervision in the finest farming localities in the country, picked at the peak of the season, and packed immediately in sanitary kitchens. Scientists in the food industry have developed methods of retaining in canned foods the maximum nutritional value of the uncooked food. Present day machinery operates so swiftly and efficiently it is possible to pack great quantities of food in a very short time, thus lowering the

cost so that canned foods are available to us all.

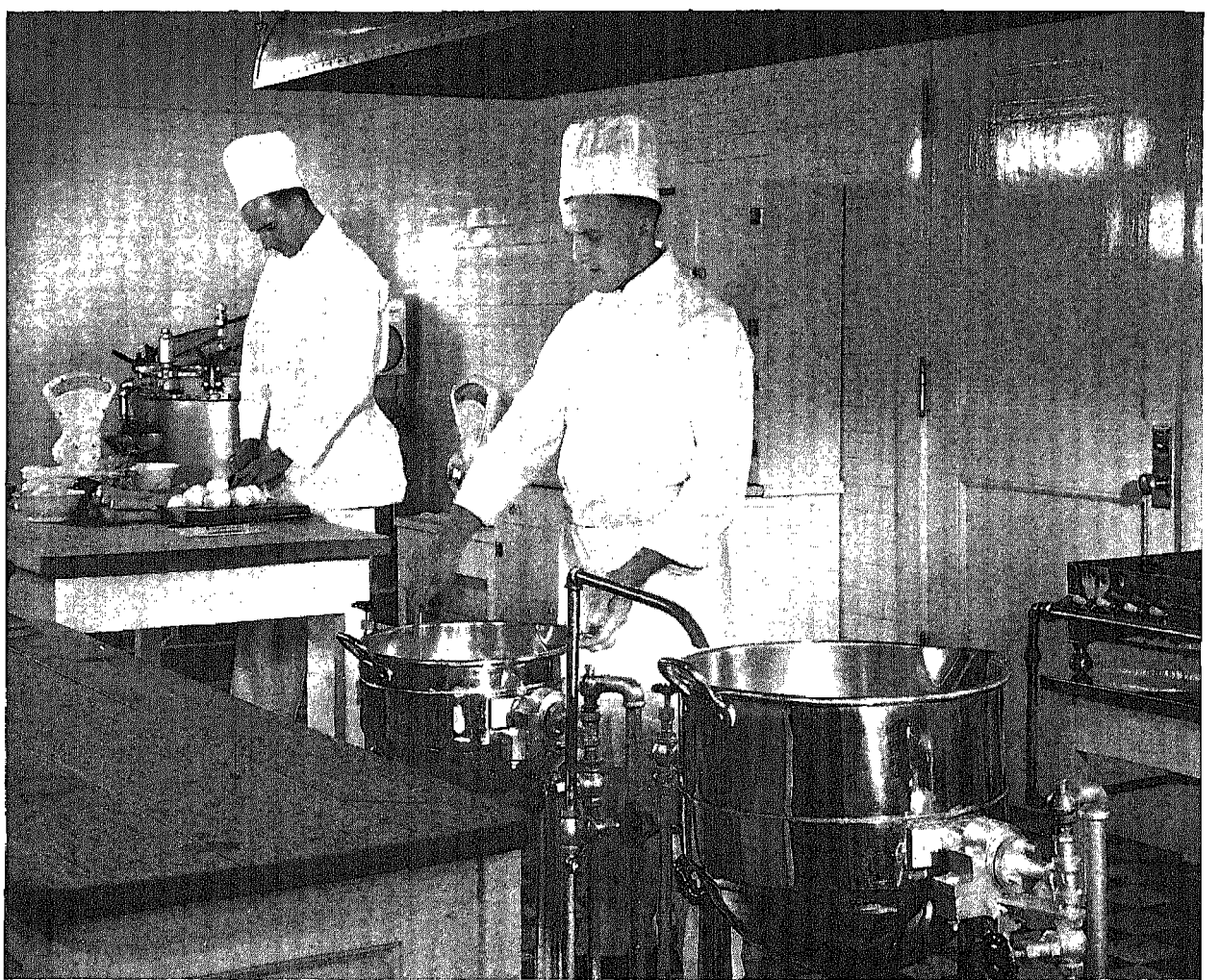
With the whole world for their gardens and markets, canning factories now pack almost every kind of food in tins, all the everyday foods that make up the staple part of our meals and the exotic luxuries we like for specialties. We have corn and beets, and peas and beans; but we also have pineapple from Hawaii, papayas from the tropics, sardines and salmon from Alaska, caviar and artichokes, bamboo sprouts and enchiladas. And we may have these foods any time we please, regardless of the season. But more important still, canning has been of almost inestimable value to the housewife in relieving her of heavy kitchen tasks. Our grandmothers spent the better part of their time cooking and baking and preserving. It was a day-in, day-out task, a drudgery that lasted all their lives. The canning industry now has eliminated many of these household chores, and has made it possible for the modern housewife to give her family delicious meals, prepared quickly and easily, at a cost that reduces the food budget to a minimum.



III. How Quality Foods Are Made

You know how hard it is to prepare a new dish that suits the taste of many people. Someone is sure to want more salt, or sugar, or a little extra seasoning of spice. No dish ever tastes quite the same even to two people. Since it is so hard to satisfy a few, you can imagine the confusing problems that must confront a food manufacturer who prepares food to please thousands and thousands of people. To do this is an enormous task, for quality food manufacturing involves much more than just appearance and flavor nowadays.

From Appert's trial and error experiments in a confectionery kitchen, the industry has progressed, until now it is conducted with an accuracy and skill unknown a century ago. Science controls every phase of the food business, from the development of new strains in agricultural stations to improved methods of serving prepared foods in the home.



H. J. Heinz Co.

AN EXPERIMENTAL KITCHEN

H. J. Heinz Co.

FLAVOR JURY

Because of the variety of foods packed nowadays, many different methods of processing are used. Some manufacturers, for instance, simply can fresh fruits and vegetables, such as peaches and peas and corn. Others produce ready-to-serve foods — soups, spaghetti, and plum pudding. Since there is this diversity within the industry itself, no one method of preparation could possibly apply to every manufacturer or every food product.

To simplify this discussion, the processing methods presented here have been confined to those used by one of the leading manufacturers of prepared food products.

The Development of a New Product

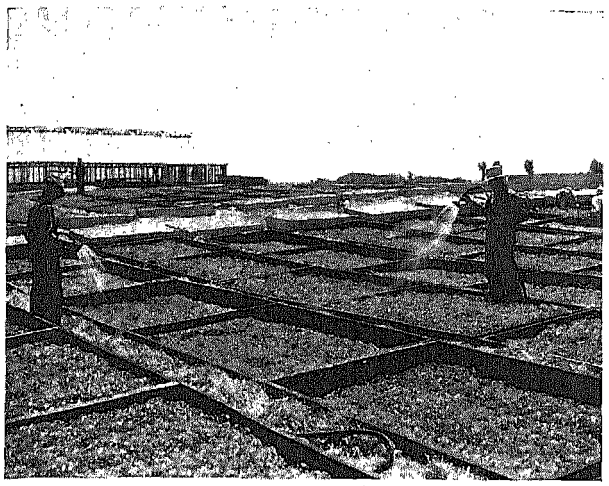
An important part of a progressive food factory is the experimental kitchens. These kitchens are gleaming white-tiled rooms with spotless stoves and sinks and shining tables of stainless steel. Here some of the world's most skillful chefs preside over the pots and pans, preparing new recipes and perfecting old favorites.

When the manufacturer wants a new product he turns the problem over to these chefs; and each chef sets to work cooking small batches of the dish of just about the right size for a family. Time and again they try their recipes, adding a pinch of this and a dash of that, until they have a product they think all your families would enjoy. Then many other people taste their dish. First the officials try the new product. And back again it will

FIELD OF SPINACH GROWN FOR CANNING

probably go to the experimental kitchens; for you know, no two people ever taste the same thing in a dish.

After the first judges have been satisfied, the recipe is tried again on a larger group of people, a flavor jury made up of members of this organization who are familiar with fine foods. These people have good everyday tastes just as you and I, and critical judgment, too, so they can discuss the new dish and suggest changes. This tasting committee meets at noontime when their appetites are keen and their tastes are clear. A large table is set with samples of the new product, and pads of paper and pencils are placed beside each plate. Around this table the tasters gather to sample the dishes and write down their decisions. Here again, some may think the food too sweet or sour or perhaps too full of spice. The color is important, too, and the texture of the food, whether it is too thick or thin, must be considered always. Then they decide whether the food looks appetizing, too, for you know appearance has a lot to do with your liking for a dish. This testing may go on for months, and after each meeting the dish may be sent back to the experimental kitchens to be changed. Finally the chefs prepare a dish that pleases everyone and the problem is turned back to the officials again.



YOUNG TOMATO PLANTS IN COLD FRAMES

PLANTING TOMATO PLANTS BY MACHINE

AN EXPERIMENTAL GROWING PLOT

The manufacturing department must consider many things before this new product can be put on the market. The food must be adapted to cooking in large quantities. In many cases laboratory experts must determine the nutritional value of the food, and plan how to increase this if need be. Then the manufacturer must decide on the type of container best suited to preserving the new product and most convenient for the housewife to handle. All these and many other details must be settled before the factory can begin packing the new product.

Selection of Materials

Of first importance both to the manufacturer and the consumer is the quality of the ingredients to be used in this new product, for it is not possible to prepare a fine food unless fine ingredients are used. Since most foods are made from plants, and plants are grown from seeds, the quality of the seeds determines to a great extent the quality of the finished product. This scientific food factory has vast experimental farms in fertile sections of the country where skilled agronomists work in fields and laboratories developing choice strains and creating new varieties. You see, sometimes even the finest of existing strains may not meet the manufacturer's need for a new product. For instance, a tomato that is perfect eaten raw, plump and firm and juicy as can be, might not be good for canning purposes at all. It might cook away to nothing or lose all its fresh ripe flavor. So these scientists set to work, breeding and cross-breeding, until they have developed the new type that is required. Once this plant has been developed the line is kept pure so that these pedigreed plants will yield a uniform crop from year to year.

When the finest seed has been selected the agronomists contract with the farmers in their communities to grow the crop for them. You see, it would not be practical for the food factory

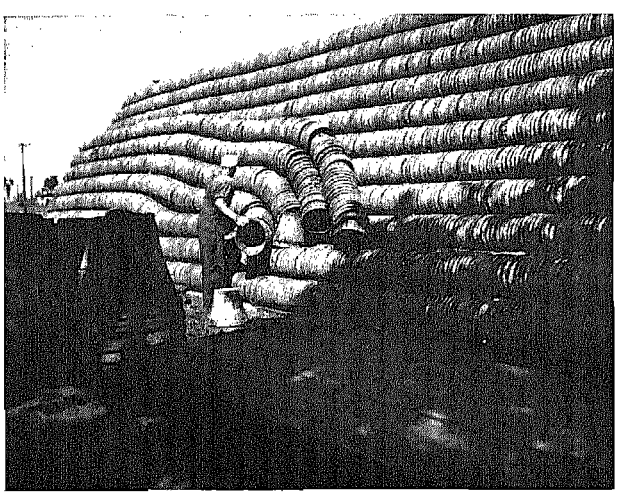
to grow these crops themselves. Just developing seeds and seedlings is an enormous job each year. Take tomato plants for instance. The tomato is a very delicate sub-tropic plant that requires great care to grow in northern climates. Millions of these tiny plants must be nurtured gently at each company owned plant growing farm in greenhouses and cold frames and inspected fields. So many highly skilled workers are needed just to care for tomato plants through the seedling stage that it would be much too great a task for the food factory to manage all the land and labor needed for growing the crops to maturity. So when spring comes, and the plants are past the most delicate stage of their development, seedlings from the pedigreed strains are provided by the food manufacturer to farmers in the locality, who grow the crop for him.

All during the growing season the agricultural experts from the station keep an eye on the crops, consulting with the farmers and helping them in every way they can. So close is this co-operation between the company agronomists and farmers that the experts even advise the farmers when to harvest their crops in some cases. A delicate crop like peas, for instance, must be harvested exactly at the peak of its maturity, when the flavor and vitamin content are highest, in order to get the full nutritional value from the food.

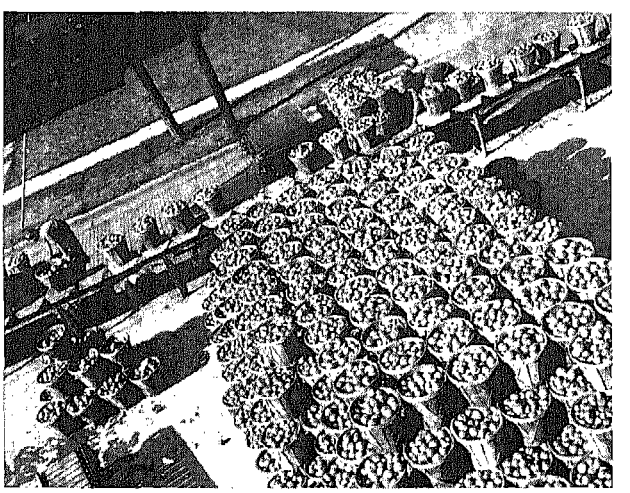
In order that no time be lost in transportation between farm and factory, scientific manufacturing plants have been built in the heart of the best growing districts where farmers can bring their crops as soon as they have been harvested. These crops are all cut and delivered to the factory according to a schedule; so they will arrive in time to be put through and cooked at once. This means a factory must operate in shifts all during the harvest season in order to handle the products immediately when they come in.

Inspection

As soon as they have harvested, the farmers pack their crops in cone-shaped baskets designed specially to prevent injury to the fruit in travel. With great care the baskets are then stacked on trucks or wagons and hauled to the canning factory. Here the trucks pull up beside a receiving platform where inspectors are stationed to examine each load before the crop can be accepted by the manufacturer. To assure the highest quality, representative sample baskets are selected at random and emptied on a grading table where all the food can be examined with care. If the fruits or



SPECIAL BASKETS USED FOR PICKING TOMATOES



UNLOADING TOMATOES AT FACTORY

vegetables meet the rigid standards required by the manufacturer the load is approved by the inspectors. The standards by which these inspectors judge a crop are fair to the manufacturer and grower, and they assure the consumer of consistently high quality raw ingredients in prepared foods. When the crop meets with these standards it is accepted and is moved on into the factory.

Here the food is emptied out of the baskets and is placed on long conveyors that move slowly before a line of keen-eyed, deft-fingered women who examine the material with great care. Slight imperfections are trimmed off and any spoiled pieces that might have slipped in are taken out and thrown away. There are a few people still who think spoiled parts are used in "seconds," but quality packers do not use spoiled food these days.

Preparation and Cooking

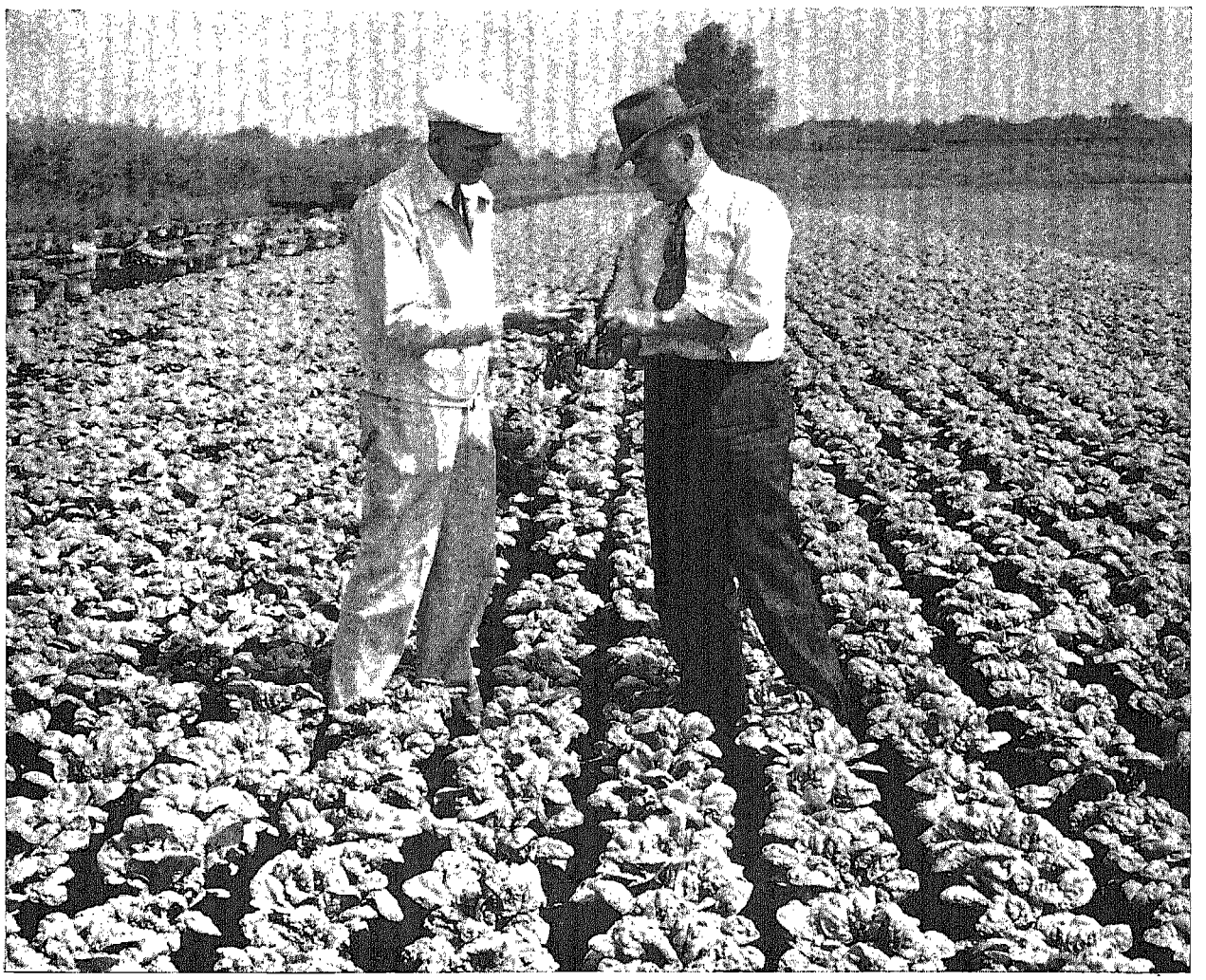
After all this scrupulous inspection the fruits or vegetables are washed thoroughly; then they are peeled or trimmed or sliced, if need be, and they are ready to be cooked. This whole process is done so swiftly and efficiently there is scarcely a stop between the time when food is brought in fresh from the field and the final canning or bottling. Prompt handling like this is most important in maintaining the garden-fresh flavor, ripe color, and high nutritive value of the food.

A number of factors must be considered in canning any food if spoilage is to be avoided. The type of food, whether acid or non-acid, is of great importance. Acid foods like tomatoes and fruits can be preserved with much less cooking than the non-acid, because acid itself destroys the bacteria and spores. Spores, you will remember, require longer cooking at higher temperatures to be destroyed; so that non-acid foods like corn and beans, which do contain spores, must be cooked longer and at a greater heat.

If preservation was the only factor to be considered, foods could be sterilized several hours at a high temperature and the canned goods would be sure to keep. But flavor is equally important, and the flavor of foods sterilized that way would be ruined. So, in working out his sterilizing time, a canner must always keep the flavor factor uppermost in mind. His problem, then, is to preserve the food and still retain as much of the fine fresh flavor as possible. To do this, the canner must develop a special sterilizing method for each kind of food. In every case the food must be sterilized the shortest time and at the lowest temperature possible for preservation in order to retain the flavor and appearance of fresh food. This time and temperature can be determined only by a great deal of experiment with each kind of food. Some foods need a short sterilizing time at a low temperature; some foods require a short sterilizing time at a high temperature; while there are still other foods that take a long sterilizing time at a very high temperature to be preserved.

The size of the cans used also affects the time and method of sterilizing a product. Food in a big can requires more sterilizing time than it does in a small can because the heat takes longer to penetrate. Then, too, the heat at the center of the can is never as great as it is in the outer part; so the outer part must reach a higher temperature than is really necessary in order for the inside to be made sterile. To overcome this, in some cases the cans are shaken, so that the food will be stirred around and be sterilized uniformly. The denseness or texture of the food is another problem that requires constant adjustment. Thick foods like baked beans call for more sterilizing than a delicate, thin substance like consommé.

All these factors must be continually checked and controlled by the canner to insure a dependable pack of high quality from year to year. And so you see, the canner's



INSPECTING SPINACH FIELD

problems are always changing and he must work constantly to keep abreast of them. No set of hard and fast rules can be formulated for canning. Instead, this scientific food packing plant has vast laboratories where dozens of skilled scientists, highly trained chemists, and efficient bacteriologists make daily check-ups on the foods being packed. This is, of course, a great additional expense, but it insures both the manufacturer and the consumer of products of the finest flavor, packed in perfect condition.

Maintenance of Uniform Quality

To maintain uniform quality in preparing many kettlefuls of food is no small problem. Suppose you decide to make a batch of ketchup at home sometime. First you go the the grocery store and buy all the ingredients you need — tomatoes, onions, vinegar, sugar, salt, and spice. Then you prepare everything according to your favorite recipe. Now the tomatoes are smooth and plump and perfectly ripened. The onions are shining and solid. The vinegar is full-bodied and fragrant. The spices are fresh and pungent. And so your ketchup comes out tart and piquant as can be. In fact, it is so good you decide to try a second batch. So, off you go to shop at the same store. But this time

the tomatoes are not evenly ripened, for the ends are hard and green. The spices have been standing on the grocer's shelf long enough to lose their pungent flavor. Some of the onions are a little soft and spongy, and the vinegar is thin and sharp. Even so, you prepare the ketchup as you did before, expecting the same results. But the tomatoes give a slightly moldy taste, the onions add a bad flavor, and the old spices seem to have no taste to them at all. And so you have a bitter disappointment.

Every food manufacturer is confronted with this same problem. That is why a scientific food plant has such rigid inspection of the raw ingredients they use. All the tomatoes and beans and peas and spinach and meat and other fruits and vegetables must be of a uniformly high quality so the finished products will look and taste alike. This inspection does not stop with just the raw ingredients either. Spices and salt and cooking utensils and even the buildings themselves are examined to avoid trouble. This progressive food plant has laboratories operated by trained men and women — chemists, biologists, and bacteriologists whose business it is to keep up the high quality of the food products. You see, it is ever so much more important for the food manufac-

H. J. Heinz Co.

A FOOD CHEMISTRY LABORATORY

H. J. Heinz Co.

BACTERIOLOGICAL LABORATORY

turer to maintain a consistently high quality than it is for you at home. When your second batch of ketchup was not good you could excuse yourself. But the food manufacturer must have every batch perfect, so that you will like his product and keep on buying it over and over again. You will only do this if the quality of his food is always the same whether you buy it today or next year or in the Middle West or East or West Coast.

A great many different kinds of tests are made in these laboratories. All the spices that go into the food are carefully checked first. Spices, for instance, may have been selected by skilled buyers from the far-away markets of the Indies and the South Sea Isles. Though they are the finest spices in the world, they are still checked in the laboratory, analyzed for impurities and measured to determine the freshness of their flavor by the strength of their essential oils. Milk and cream are tested to see that they are fresh and pure and rich. Other foods like dried beans for baking are tested for their water content. The percentage of acid present in vinegar is checked carefully, and there are many other tests that you would never think of doing in your own cooking. All these things contribute to the fine quality of the prepared foods you buy.

The color of ketchup, for instance, must be

uniform regardless of where the tomatoes are grown and packed. You have probably noticed in the grocery store that some varieties of tomatoes are pink while others are a deep red. And yet both are fully ripe. These two kinds of tomatoes may make equally good ketchup, but the colors of the two batches will be different. In order to maintain a uniform color only selected fruit is used. Artificial coloring is prohibited in ketchup by the Pure Food Laws.

Sampling

You remember how important it is for the canner to destroy the microorganisms present in food. Samples of freshly processed food are sent frequently to the laboratory to be tested. Even after the food has been packed in cans, samples are opened and tested to see that the food has been sterilized properly. Many branch factories have laboratory facilities working in close collaboration with the main laboratory, so that no time will be lost between cooking and testing. But even though the food has been tested in the local laboratory, samples are sent frequently to the main laboratory in order that additional tests may be made. The laboratory even analyzes all metals with which the food comes in contact, so that no contamination can injure the food in any way. Maintaining all these laboratories and running

H. J. Heinz Co.

A DEMONSTRATION KITCHEN

constant tests is of course expensive, but it is a most important way to assure dependable products for the consumer.

After all the chemical and bacteriological tests have been made, the food still must be checked for flavor. There is no laboratory method for checking flavor, so that samples must be tasted frequently by experts to see that the food is up to standard. With the great care taken in manufacturing it is scarcely possible for the taste of any food to vary. This taste-testing is just an added precaution to assure the consumer of uniformly high quality food.

Cleanliness

Maintaining immaculate working conditions is as important as any other factor in canning food. To keep well, canned food must be clean food. As you can imagine, keeping a food factory clean is a never ending task. All the employees must be spotless; their uniforms clean, their hair completely covered by caps, and their hands in good condition. Then the factory itself must be built so that it can be cleaned easily. Walls and floors and ceilings are painted frequently. Water pipes run everywhere so that hoses can be connected to reach all parts of the buildings. The floors are flushed regularly with these hoses, and several times a day the machines are washed with powerful jets of water. At night-time a special crew of cleaners wash and polish up the factory till it shines, sterilizing the machinery and kettles by scalding them with steam. All this adds more to the manufacturer's expense, but it helps to assure clean food for the consumer.

Consumers' Aids

Even after the manufacturer has canned and sold his products his responsibility to the consumer is not ended, for he aids the consumer still further by suggesting new and interesting ways to use his foods. As they come from the container these prepared foods are as nearly perfect as can be — fully cooked and seasoned and ready to serve. Chilling or heating is generally all that is required to serve these foods. But in recent years the uses for canned foods have expanded far beyond this simple purpose. Food authorities now say that perhaps the greatest value to be derived from canned foods is the wide variety of dishes that may be prepared by combining canned products with other foods. In this way many interesting and varied dishes are created from one basic canned food.

To help the consumer in preparing delicious combinations of canned foods, leading food manufacturers maintain large home economics departments staffed with dietitians and food experts. These home economists develop brand new combinations, adapt favorite old-fashioned recipes to canned foods, build well-balanced menus around their dishes, and create clever ways to serve them. Time and again their recipes are tested until every detail has been standardized; then they are made available to the consumers in newspaper food columns, the homemaking sections of women's magazines, radio programs, and in advertising material. Often the most popular combinations are printed in pamphlets and cookbooks distributed by the manufacturer. This new use for canned foods is also demonstrated in cooking classes conducted by the home economists, who not only teach, but serve as an advisory board to answer questions.

And so you see how food manufacturers pack quality products nowadays. The development of choice new strains, research in agronomy, supervision in the field, stringent inspection at the factories, sterilized machinery, and laboratory supervision all help to maintain the high standards set by the industry itself. This scrupulous regard for quality in every detail of manufacturing from seed to seal assures you of fine foods at a fair cost both to manufacturer and consumer alike.

IV Bibliographical Notes

TO mention all the material assembled in the preparation of this book would make a longer bibliography than would be necessary or practical. Some of this information comes from sources available only in large city libraries; some would add nothing to the facts already included in the text. So, in order not to complicate the reader's problems, we are listing here only those books and pamphlets which will be helpful in expanding the material already presented, or in providing additional details. While no encyclopedia has been cited, any standard edition will be found to contain much excellent information on the subject of food preservation.

INTRODUCTION

One of the best general studies of primitive man is to be found in H. G. Wells, *The Outline of History*, New York: The Macmillan Company, 1921. Hendrick Van Loon, *Ancient Man*, New York: Boni and Liveright, Inc., 1922, contains a fine simple treatment of the subject for children. A short but comprehensive account of early man, and a good bibliography for supplementary reading, is available in a pamphlet by George Grant MacCurdy, *Prehistoric Man*, Chicago: American Library Association, 1928.

CHAPTER I

The most satisfactory general discussion of food spoilage is Thomas M. Rector, *Scientific Preservation of Food*, New York: John Wiley and Sons, Inc., 1925. Additional reference material on this subject may be found in chemistry, botany, and biology text books.

CHAPTER II

Much excellent general information on food in the United States is included in Richard Osborn Cummings, *The American and His Food*, Chicago: The University of Chicago Press, 1940. Lyman Carrier, *The Beginnings of Agriculture in America*, New York: McGraw, 1923, also contains useful background material. Samuel C. Prescott and Bernard E. Proctor, *Food Technology*, New York: McGraw-Hill Book Company, 1937, is a recent and authoritative work on all modern food processes. A detailed discussion of various phases of the manufacturing and preserving methods used with fruits and vegetables is available in W. V. Cruess, *Commercial Fruit and Vegetable Products*, New York: McGraw-Hill Book Company, 1938. A study of all these books will give a general background knowledge of the development and progress of the food industry in America. For a more specific treatment of various divisions of the food industry many interesting books are accessible. Robert Byron Hinman and R. B. Harris, *The Story of Meat*, Chicago: Swift and Company, 1939, is an excellent presentation of the meat industry. A comprehensive description of the products of the sea, and a discussion of their uses for food and other purposes, is given in Donald K. Tressler, *Marine Products of Commerce*, New York: Reinhold Publishing Corporation, 1940. In a folder *The Fisheries*, Gloucester: Gorton-Pew Fisheries Company, Ltd., 1939, an interesting historical sketch of the fishing industry and a discussion of modern methods of operation are presented. For historical background on American foods, Alice Morse Earle, *Home Life in Colonial Days*, New York: Macmillan Company, 1898, *Child Life in Colonial Days*, New York: Macmillan Company, 1922, *Stage Coach and Tavern Days*, New York: Macmillan Company, 1900, etc., contain interesting bits of folk lore and facts on regional food. Though dealing chiefly with conditions in western Pennsylvania, Solon J. Buck and Elizabeth Hawthorn Buck, *The Planting of Civilization in Western Pennsylvania*, Pittsburgh: University of Pittsburgh Press, 1939, includes information on food pertinent to all pioneer communities. Herman Theodore Vulte and S. B. Vanderbilt, *Food Industries*, Easton: Chemical Publishing Company, 1928, contains extensive information on various phases of the food industry suited to students in the more advanced grades. Listed under *Foods* and *Food Preservation* in any of the standard encyclopedias much helpful material may be found. An informative article on the food of the American Indians appears in the Bureau of American Ethnology, Bulletin 30, *Handbook of American Indians*, Washington: Government Printing Office, 1907.

STORAGE. The paragraphs on the food storage habits of squirrels are quoted from Peter Kalm, *Travels into North America*, Warrington: 1770. In a recent American translation, Adolph B. Benson, editor, New York: Wilson-Erickson, 1937, substantially the same account may be found. Many other interesting details of colonial life are included in this volume. The following bulletins from the United States Department of Agriculture, Washington: Government Printing Office, also contain useful details on storage: *Ripening, Storage and Handling of Apples* (Farmers' Bulletin 1406); *Corncribs for the Corn Belt* (Farmers' Bulletin 1701); *Home Storage of Vegetables* (Farmers' Bulletin 879); *Farm Bulk Storage for Small Grains* (Farmers' Bulletin 1636); *Potato Storage and Storage Houses* (Farmers' Bulletin 847).

HARMFUL CHEMICAL PRESERVATIVES. The story of harmful chemical preservatives and legislative efforts to

control their use is well handled in Dr. Harvey Wiley, *An Autobiography*, Indianapolis: Bobbs-Merrill Company, 1930.

SALT. Tales of pioneer life are told in Emerson Hough, *The Way to the West*, Indianapolis: Bobbs-Merrill Company, 1903. Included in this volume are biographical sketches of such leading frontiersmen as Daniel Boone, Kit Carson, and Davy Crockett. An excellent discussion of the importance of pioneer tools: the rifle, the ax, the boat, the kettle, the plow, etc., is presented here. The novels of Joseph Hergesheimer, particularly *The Limestone Tree*, New York: Alfred A. Knopf, 1931, give realistic pictures of life among the early settlers and contain much useful and authentic information. Comprehensive material on salt making is included in William C. Phalen, *Technology of Salt Making in the United States*, Washington: Government Printing Office, (Bureau of Mines Bulletin 146). Pertinent details on salt may be found in Samuel C. Prescott and Bernard E. Proctor, *Food Technology*, New York: McGraw-Hill Book Company, 1937, by referring to "Salt" in the index. The encyclopedia is also a valuable source of information on this subject. Interesting facts on salt may be found in the Carnegie Library, Pittsburgh, in Mary Rinehard Hoge, *Salt On The Frontier* (master's thesis, 1931). Present day methods of salt production are explained in a pamphlet prepared by International, *Salt*, Scranton: International Salt Company, Inc., 1939.

VINEGAR. A number of books are available on John Chapman, known traditionally as Johnny Appleseed, though since the details of his life are obscure and some of his accomplishments more or less legendary, most books have considerable variation in their stories. Among the best is Newell Dwight Hillis, *The Quest of John Chapman*, New York: Macmillan, 1904. For additional material on the apple, see: *Apple Growing East of the Mississippi River* (Farmers' Bulletin 1360); *Apple Recipes* (Agricultural Adjustment Administration, 1937). Edwin LeFevre, *Making Vinegar in the Home and on the Farm* (Farmers' Bulletin 1424) contains a good general discussion of modern methods of vinegar making. A thorough and authoritative technical treatment of commercial vinegar production is presented in Charles Ainsworth Mitchell, *Vinegar, Its Manufacture and Examination*, London: Charles Griffin and Company, 1916.

WOOD SMOKE. Only fragmentary references to smoking are available as the story is comparatively simple. Larger libraries generally list a few technical books published for the meat packer containing factory details. Samuel C. Prescott and Bernard E. Proctor, *Food Technology*, New York: McGraw-Hill Book Company, 1937, devotes a number of pages to this subject. Also helpful is Robert Byron Hinman and R. B. Harris, *The Story of Meat*, Chicago: Swift and Company, 1939. In several of the government publications such as *Pork on the Farm* (Farmers' Bulletin 1186), and *Beef on the Farm* (Farmers' Bulletin 1415) details of smoking are discussed. An interesting description of an old-fashioned butchering day on a farm is included in Della Lutes, *Home Grown*, Boston: Little, Brown and Company, 1937.

SUGAR. For material additional to the text on grasses, bamboo, and sugar cane, consult botany text books and standard encyclopedias. Samuel C. Prescott and Bernard E. Proctor, *Food Technology*, New York: McGraw-Hill Book Company, 1937, contains pertinent material on the manufacturing processes used in various kinds of sugar. Albert H. Byron, *Production of Maple Sirup and Sugar* (Farmers' Bulletin 1366) gives useful information on farm methods of making maple sugar. References to sugar making are found frequently in general literature, particularly in such books as those of Mrs. Alice Morse Earle, previously listed. Richard Osborn Cummings, *The American and His Food*, Chicago: University of Chicago Press, 1940, contains good information on this subject. The United States Department of Agriculture publishes an Educational Chart on *Sugar Beets* from which excellent material may be secured. Also useful is a United States Department of Agriculture pamphlet on sugar, *Separate 893*, reprinted from the *Agricultural Yearbook*, 1923, in which information on the growing of cane and beets and the manufacturing of sugar is presented.

SPICES. Some edition of the travels of Marco Polo is usually obtainable in most libraries. The volume edited by Manuel Komroff, *The Travels of Marco Polo*, New York: Boni and Liveright, 1926, has an interesting introduction in which the background for the travels and life of Marco Polo is told with dramatic detail. Histories and encyclopedias will provide good material on other explorers. Dr. Nicholas Monardes, *Joyfull Newes out of the Newe Founde Worlde*, New York: Alfred A. Knopf, 1925, is a modern edition available in many large libraries, but it is not suitable for classroom use. For an authoritative account of the use of spices in the preparation of foods, and the food habits of the Middle Ages, see William Edward Mead, *The English Medieval Feast*, London: Allen and Unwin, 1931. Interesting material on the history, cultivation, and uses for spices is included in H. Stanley Redgrove, *Spices and Condiments*, London: Pitman, 1933, and Henry N. Ridley, *Spices*, New York: Macmillan Company, 1912, available in larger libraries. Listed separately, under the names of the various spices, useful facts will be found in encyclopedias.

DRYING. Helpful information about the American Indian can be found under various headings in the Bureau of American Ethnology, Bulletin 30, *Handbook of American Indians*, Washington: Government Printing Office,

1907, or, perhaps more pertinent for school use, will be the works of George Bird Grinnell. The story of the life of an Indian boy is told with sympathetic insight in George Bird Grinnell, *When Buffalo Ran*, New Haven: Yale University Press, 1920. *Pawnee Hero Stories and Folk Tales*, New York: Charles Scribner's Sons, 1904, and *Blackfoot Lodge Tales*, New York: Charles Scribner's Sons, 1903, also afford fine realistic details of Indian life and customs. A pamphlet published by the Dried Fruit Research Institute, *The Story of Dried Fruits*, San Francisco: 1938, contains an informative discussion of the industry and its processes. *Farm and Home Drying of Fruits and Vegetables* (Farmers' Bulletin 984) also presents useful material on dehydration.

PRESERVATION AT LOW TEMPERATURES. Pertinent facts on ice and refrigeration are available in Richard Osborn Cummings, *The American and His Food*, Chicago: The University of Chicago Press, 1940. Eleanor Howe, *The Romance of Ice*, Chicago: The National Association of Ice Industries, 1936, includes good background material. Robert Byron Hinman and R. B. Harris, *The Story of Meat*, Chicago: Swift and Company, 1939, traces the development of the refrigerator car, a most important element in our present day economy. Donald K. Tressler and Clifford F. Evers, *The Freezing Preservation of Fruits, Fruit Juices and Vegetables*, New York: Avi Publishing Company, 1936, if available, will supply fine factual material on various freezing and cold storage methods. Samuel C. Prescott and Bernard E. Proctor, *Food Technology*, New York: McGraw-Hill Book Company, 1937, and W. V. Cruess, *Commercial Fruit and Vegetable Products*, New York: McGraw-Hill Book Company, 1938, both include useful information on cold storage and freezing. In a publication of the United States Department of Agriculture, *Suitable Storage Conditions for Certain Perishable Products* (Bulletin 729) and explanation of the methods used in cold storage is given. *Harvesting and Storing Ice on the Farm* (Farmers' Bulletin 1078) contains an interesting description of home production methods.

CANNING. A comprehensive, popular account of the canning industry will be found in Earl Chapin May, *The Canning Clan*, New York: Macmillan Company, 1937, and in James H. Collins, *The Story of Canned Foods*, New York: E. P. Dutton and Company, 1924. An interesting presentation of Appert's original work, translated and published privately by K. G. Bitting, is available in Nicholas Appert, *The Book of All Households*, or *The Art of Preserving Animal and Vegetable Substances for Many Years*, 1920. This book contains a report of the methods by which Appert won the award offered by the French government for the solution of the food preservation problem; and includes recipes for cooking certain foods, which represent the sum of Appert's research. In a book by Dr. A. W. Bitting, *Appertizing*, San Francisco: Trade Pressroom, 1937, an all-inclusive work on canning, Dr. Bitting applies to canning the name "appertizing," which he has coined in consideration of the work of Appert. Louise Stanley and Mabel C. Stienbrager, *Home Canning of Fruits, Vegetables and Meats* (Farmers' Bulletin 1762) gives a thorough resumé of latest methods used in home canning as recommended by the United States Department of Agriculture. Of great interest to those who read French will be an account of the research of Louis Pasteur, *Oeuvres Reunies par Pasteur*, Paris: Masson et Cie, 1922. Paul de Kruif, *Microbe Hunters*, New York: Harcourt-Brace and Company, 1926, tells the story of Pasteur's work, and research and discoveries of other early investigators in a dramatic manner. The National Canners' Association, Washington, D. C., has published a number of pamphlets on canned foods among which, *The Story of the Tin Can*, *Canned Food Facts*, *The Story of the Canning Industry*, and *Vitamins in Canned Foods*, contain particularly useful presentations of material. Also helpful are a number of booklets on specific canned food products published by the American Can Company: *The Story of Salmon; The Hawaiian Islands and the Story of Pineapple;* and *The Story of Coffee.* A pamphlet published by the Continental Can Company, *The Nutritive Value of Canned Foods*, includes material pertinent to this field. A *Nutritional Chart*, prepared by the research department of H. J. Heinz Company, is an authoritative presentation of the nutritive value of many foods, arranged in a concise and practical form suitable for advanced classroom use. The home economics departments of many food companies also publish attractive bulletins and booklets on uses for their products.

General Index